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VOLUME III

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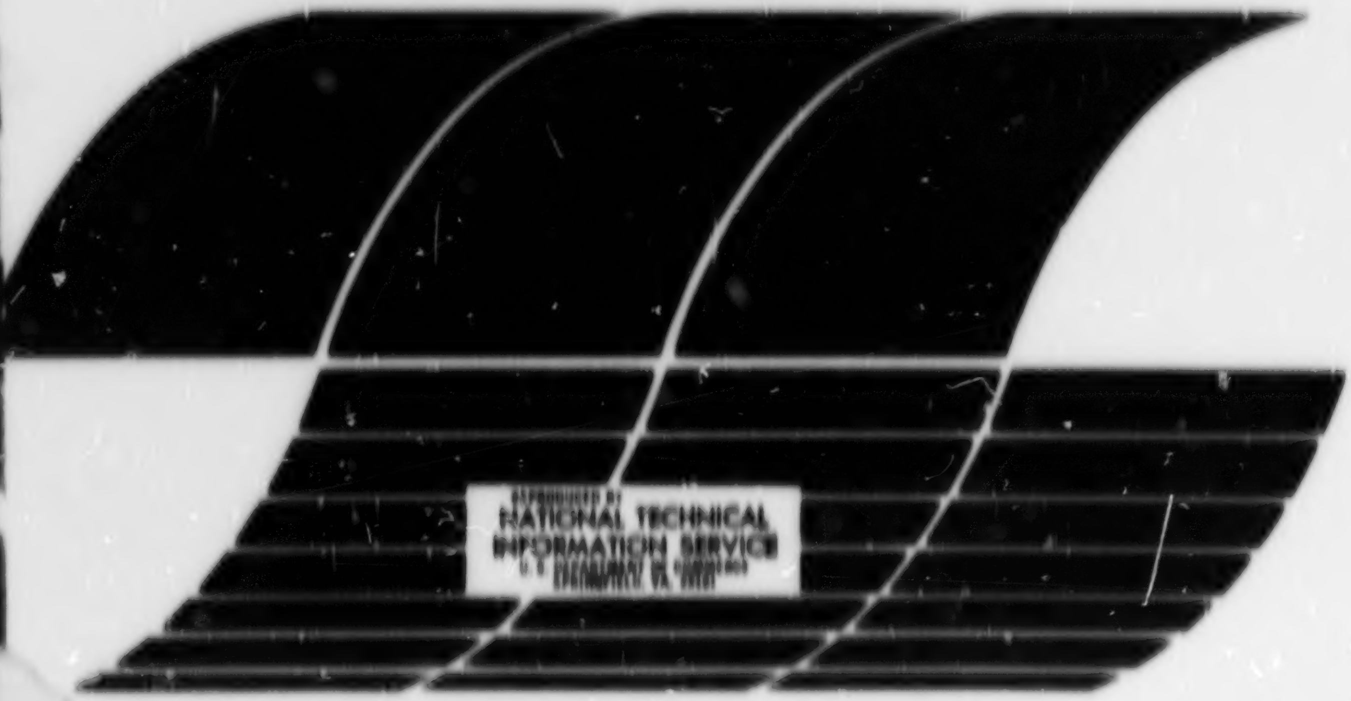

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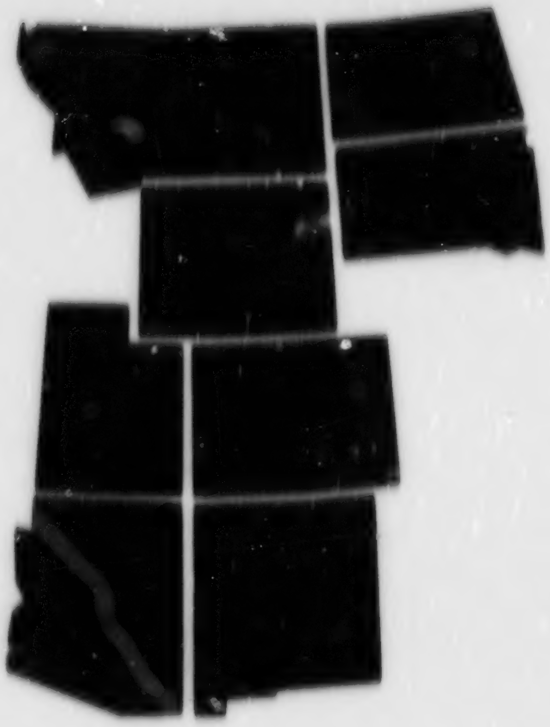

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FOREWORD

The production of electricity and fossil fuels inevitably creates adverse impacts on Man and his environment. The nature of these impacts must be thoroughly understood if balanced judgements concerning future energy development in the United States are to be made. The Office of Energy, Minerals and Industry (OEMI), in its role as coordinator of the Federal Energy/Environment Research and Development Program, is responsible for producing the information on health and ecological effects - and methods for mitigating the adverse effects - that is critical to developing the Nation's environmental and energy policy. OEMI's Integrated Assessment Program combines the results of research projects within the Energy/Environment Program with research on the socioeconomic and political/institutional aspects of energy development, and conducts policy - oriented studies to identify the tradeoffs among alternative energy technologies, development patterns, and impact mitigation measures.

The Integrated Assessment Program has utilized the methodology of Technology Assessment (TA) in fulfilling its mission. The Program is currently sponsoring a number of TA's which explore the impact of future energy development on both a nationwide and a regional scale. For instance, the Program is conducting national assessments of future development of the electric utility industry and of advanced coal technologies (such as fluidized bed combustion). Also, the Program is conducting assessments concerned with multiple-resource development in three "energy resource areas":

- Western coal states
- Lower Ohio River Basin
- Appalachia

This report describes the results of the first phase of the Western assessment. This phase assessed the impacts associated with three levels of energy development in the West. The concluding phase of the assessment will attempt to identify and evaluate ways of mitigating the adverse impacts and enhancing the benefits of future development.

The report is divided into an executive summary and four volumes:

- I Summary Report
- II Detailed Analyses and Supporting Materials
- III Preliminary Policy Analysis
- IV Appendices

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ABSTRACT

This is a progress report of a three year technology assessment of the development of six energy resources (coal, geothermal, natural gas, oil, oil shale, and uranium) in eight western states (Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah, and Wyoming) during the period from the present to the year 2000. Volume I describes the purpose and conduct of the study, summarizes the results of the analyses conducted during the first year, and outlines plans for the remainder of the project. In Volume II, more detailed analytical results are presented. Six chapters report on the analysis of the likely impacts of deploying typical energy resource development technologies at sites representative of the kinds of conditions likely to be encountered in the eight-state study area. A seventh chapter focuses on the impacts likely to occur if western energy resources are developed at three different levels from the present to the year 2000. The two chapters in Volume III describe the political and institutional context of policymaking for western energy resource development and present a more detailed discussion of selected problems and issues. The Fourth Volume presents two appendices, on air quality modeling and energy transportation costs.

READER'S GUIDE

This report is divided into four volumes. In addition, an executive summary provides a brief description of the major research results of this western assessment.

Readers interested in a general description of the assessment results should read Volume I. Chapters 1 and 2 describe the context and methodological framework of the assessment. Chapter 3 provides a summary description of the impact analysis, e.g., water and air impacts, population changes, etc. Chapter 4 summarizes some policy implications of these results, although the assessment is still in the early stages of policy analysis at this time. Chapter 5 briefly describes what the reader can expect from the second phase of the project.

Readers interested in particular geographical areas might be interested in one or more of the six site-specific chapters (Chapters 6-11) of Volume II which describe in detail results pertaining to the following areas: Kaiparowits/Escalante, Utah; Navajo/Farmington, New Mexico; Rifle, Colorado; Gillette, Wyoming; Colstrip, Montana; and Beulah, North Dakota. Readers interested in site-specific air, water, socio-economic and ecological impacts will find these discussed in subsections 2, 3, 4, and 5, respectively, of each chapter in this volume. Chapter 12 in volume II describes the results of the regional analyses. This chapter should be particularly valuable to readers interested in transportation, health, noise and aesthetic impacts, which are not discussed in the site-specific chapters, and subjects (such as water availability) which tend to be regional rather than site-specific in nature.

Volume III represents a first step in the identification, evaluation and comparison of alternative policies and implementation strategies. Chapter 13 presents a general overview of the energy policy system. Chapter 14 identifies and defines some of the principal problems and issues that public policymakers will probably be called on to resolve. The categories of problems and issues discussed are: water availability and quality, reclamation, air quality, growth management, housing, community facilities and services, and Indians.

Volume IV provides two technical appendices:

o a discussion of alternative approaches to modeling air quality in areas with complex terrain

o cost comparisons of unit trains, slurry pipelines and EHV transmission lines

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PART III

PRELIMINARY POLICY ANALYSIS

INTRODUCTION

As stated in Chapter 1, the purposes of this technology assessment of western energy resource development are: to identify a broad range of consequences likely to result from the development of western energy resources; and to identify, evaluate, and compare policies and implementation strategies for dealing with these consequences. In short, our overall purpose is to better inform policymakers about the likely consequences of their actions. While this study cannot eliminate the uncertainties inherent in policymaking for western energy resource development, it is intended to help to reduce them.

During the first year, the research team's efforts have been devoted primarily to developing a coherent, workable analytical structure. This basic structure, which has now been established and tested, is reflected in the results of the impact analyses reported in Part II above. Although these impact analyses will be refined and extended, the research team will concentrate primarily on policy analyses during the remaining years of the study.

The following two chapters represent a first step in the identification, evaluation, and comparison of alternative policies and implementation strategies. Chapter 13 presents a general overview of the energy policy system which sets the overall context within which the problems and issues associated with western energy development will be addressed. The history of the energy policy system is briefly reviewed, some major public and private sector participants are identified, and four energy policy subsystems are discussed.

As the summary of impacts in Chapter 3 indicate, the impacts of western energy resource development occur at local, state, regional, and national levels. Public and private policymakers at each of these levels are confronted by problems and issues that arise as a consequence of these impacts. In Chapter 14, an effort is made to identify and define some of the principal problems and issues that public policymakers will probably be called on to resolve. In some of these discussions, selected alternative policies are described. However, no effort has been made during the first year to carry out the kind of systematic identification, evaluation, and comparison of alternative policies and implementation strategies that will be conducted during the remainder of the project.

The categories of problems and issues singled out for attention in Chapter 14 are: water availability and quality, community services and facilities, air quality, Indians, and reclamation. No attempt has been made to assign priorities to these problems and issues; thus, neither the order nor length of presentation should be viewed as reflecting the significance of the issues. These problem and issue categories are identified to illustrate the range of additional problems and issues that will receive attention during the next two years. As stressed above, the analyses reported in this chapter should be viewed as being both tentative and exploratory. They are intended to provide some of the background knowledge that the Science and Public Policy-Radian research team had to acquire before proceeding to the systematic policy analyses that will now become the central focus of the project.

CHAPTER 13

THE ENERGY POLICY SYSTEM

13.1 INTRODUCTION

This chapter provides a general overview description of the existing context for western energy policymaking.[1] Important evolutions in the energy policy system that have affected the participants and the relationships among those participants are identified, emphasizing existing uncertainties about institutional rules and relationships. Public and private sector participants are then identified and described.

Concern for the environment and the realization that energy resources are scarce have resulted in a variety of new participants demanding access to energy policymaking. In the public sector, new participants include local and state governments which had previously been content to remain largely outside the energy policymaking system, and interstate organizations, some of which have been formed to deal explicitly with energy problems. Resource scarcity and uncertainty about future supplies have also led to an expansion of the role of the federal government as an owner, producer, and consumer of energy and as an overseer of national energy policy. This expansion has occurred despite a continuing debate over appropriate roles of the public and private sectors.

Significant changes are also developing within the private sector, including the growth of energy conglomerates, active participation by environmental interest groups (largely through public hearings and the courts), and the emergence of groups representing such special interests as those of consumers, agriculture, and Indian tribes.

This chapter also briefly describes four energy policy subsystems that have developed around coal, oil, gas, and electricity. This description identifies some of the major professional associations that represent those energy industries and examines the relationship of the industries to outside interest groups such as labor unions. Further, the internal structures, economic resources, and relative access to the policy subsystem of each of these industries are briefly examined.

---

[1] This chapter is a slightly modified version of Chapter 3 in Kash, Don E., *et al*. *Our Energy Future: The Role of Research, Development, and Demonstration in Reaching a National Consensus on Energy Supply*. Norman, Okla.: University of Oklahoma Press, 1976, pp. 28-53.

13.2 HISTORY OF THE ENERGY POLICY SYSTEM

Energy policymaking in this country has evolved through three distinct, but overlapping, periods. The first period, the nineteenth century, was characterized by abundant resources and little competition among private developers. In the second period, which includes most of the twentieth century, the federal government began to allocate resources among the various companies that were competing for development rights. The present period, which began in the 1960's has been characterized by the emergence of new policymaking participants who broaden the range of viewpoints that must be considered in energy resource development.

The present energy policy system represents a complex mixture of the institutions and processes that evolved in each of these three periods. For example, the General Mining Law of 1872 allows some federally owned resources, such as uranium, to be extracted by private interests after a claim has been filed. Conversely, the Outer Continental Shelf (OCS) Lands Act of 1953 requires competitive bidding for resource development on the OCS. Also, the impact assessment requirement of the National Environmental Policy Act of 1969[1] provides new participants an opportunity to challenge and often overturn decisions made under the terms of older legislation. In the following discussion, the three historical periods are briefly outlined to characterize the complexity of the present energy policy system.

Prior to the nineteenth century, a *laissez-faire* philosophy dominated domestic resource allocation and development. Government generally adopted a "hands-off" attitude toward private sector energy activities, while a "pork barrel" process governed development within the public sector. Central to both processes was the assumption that resources were almost infinite in character.[2] In accordance with this perception of the "free and open" nature of both the public and private domain for resource development, extraction processes were codified, energy prices were subsidized, and energy consumption was encouraged without consideration for environmental costs.[1] The federal government used public land distribution as a source of revenue; public resources rapidly passed into private hands through such programs as homestead allowances and grants to the railroads. Perhaps most significant, both government and industry treated each of the abundant energy resources as a separate entity during this period.

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[1] National Environmental Policy Act of 1969, § 102(2)(c), 42 U.S.C.A. § 4332(2)(c) (1973).

[2] Gilmour, Robert S. "Political Barriers to a National Policy." *Academy of Political Science Proceedings*, Vol. 31 (December 1973), pp. 184-86.

Succeeding, but not eliminating, the processes of this early period, patterns of pluralism developed that resulted in the representation of varied and competing interests in the policymaking arena.[2] With the growing realization that energy resources were indeed finite, this political process came to dominate the energy system around the close of the nineteenth century. Government could no longer pursue an energy policy that consisted mainly of responses to individual private interests. Rather, government was increasingly required to allocate resources and effect compromises among multiple interests.[3]

Today, pluralism clearly continues to characterize energy policymaking. In fact, since the 1960's, the representatives of several potentially potent new interests have begun to participate in energy policymaking. Many of these new interests have been affected by shorter supplies, increased competition among users, and increased concern about potential negative impacts associated with domestic energy development. Thus, the energy policy system is now both highly pluralistic and unstable.

Before the 1973 boycott, energy policy was made within relatively self-contained policy subsystems organized around five sources or types of energy: coal, oil, natural gas, electricity, and nuclear power.[4] Also, relationships between government and industry varied greatly from one of these subsystems to another; for instance, government played a rather small role in the coal system but a major role in the nuclear system.

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[1] Krutilla, John V., and R. Talbot Page. "Towards a Responsible Energy Policy." Policy Analysis, Vol. 1 (Winter 1975), p. 78.

[2] Lord, William B., and Maurice L. Warner. "Aggregates and Externalities: Information Needs for Public Natural Resource Decision Making." Natural Resources Journal, Vol. 13 (January 1973), p. 108.

[3] Gilmour, Robert S. "Political Barriers to a National Policy." Academy of Political Science Proceedings, Vol. 31 (December 1973), pp. 186-88.

[4] Davis, David H. Energy Politics. New York, N.Y.: St. Martin's Press, 1974.

Since the boycott, however, several actions have resulted in a blurring of boundaries among the five subsystems. At the federal level, the creation of the Federal Energy Administration and the Energy Research and Development Administration reflect efforts to address "energy" rather than particular energy resources. The movement of the oil companies into coal and uranium production reflects a similar trend toward an "energy" perspective in the private sector. And this broader perspective is also held by some of the new participants in energy policymaking. While this new broader energy perspective has made it increasingly difficult to continue the old patterns of policymaking, there still are participants who maintain a narrow perspective and who participate in policymaking in only one or more energy policy subsystems.

The difficulty is clearly reflected in the debate over a redefinition of appropriate public-private relationships. For example, since 1973, government has: begun to underwrite large scale coal research aimed at developing technologies for use in the private sector; exercised the right to regulate oil prices; and sought to transfer responsibility for uranium enrichment from government to the private sector. While these actions may appear uncoordinated, and, at times, contradictory, they are the results of pressures generated by the new participants in energy policymaking.

Overall then, the public role is clearly expanding, but the full extent of government's role is yet to be determined. Until a new consensus is evolved and policies are stabilized, the utilization of new technologies and sources for domestic energy supply will be hindered by uncertainties about institutional roles and relationships.

13.3 PARTICIPANTS IN THE ENERGY POLICY SYSTEM

When energy was still abundant, the energy policymaking system, though fragmented, was characterized by both a high degree of stability and a relatively clear differentiation between the policy roles of the public and private sectors. Each sector could predict with a fairly high level of certainty the future actions of the other. Now, resource scarcities, spotlighted by the Arab oil boycott, have broken a quartercentury of relative stability, and energy policymaking has become quite uncertain.[1] Both governmental and industrial roles in the energy system have become more complex and less clearly delineated. Policies in both sectors have tended to be piecemeal and ad hoc. Government agencies with major energy policy roles have proliferated and administrative and political jurisdictional overlaps have become more complex. Industry associations and energy related interest groups have also proliferated.

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[1] Boulding, Kenneth E. "The Social System and the Energy Crisis." Science, 184 (April 19, 1974), p. 255.

This section describes some of the major public and private participants in the contemporary energy policy system. For the most part, the discussion focuses on policymaking at the national level. However, in many respects, the western region is a microcosm of the larger policy system. Owing to the vast quantities of resources located in the West and the range of consequences likely to be associated with their development, participants at all levels of government and from other geographic regions will obviously be affected by western energy policymaking.

13.3.1 Government Participants

At each level of government, institutions and processes have been developed to respond to energy related issues. This section briefly outlines the federal, state, local, and intergovernmental participants in the energy policy system.

A. Federal Government

The federal government plays two primary roles in energy development: external "overseer" and active participant.[1] In its oversight role, government, in principle, attempts to coordinate energy decisions with decisions made in other relevant policy areas (such as the development of environmental standards), coordinate energy goals with broader national goals (for example, national defense and foreign policy objectives), and balance the social costs and benefits of energy policies (as it does with the dual issues of inflation and unemployment).

Government is also an owner, producer, and consumer of energy. In this role, government is an "economic actor". Most government participation of this type results from its extensive energy resource holdings. For example, the federal government owns more than half of the coal reserves in the eight-state study area. For the most part, responsible federal officials (such as the Secretary of the Interior) have wide discretionary authority in managing these resources. And state officials have virtually no control over development of federally owned resources within their state.

Government has also become a major energy producer through the creation of such electric power generation agencies and projects as the Bonneville Power Administration and the Colorado River Basin Storage Project. Finally, the government is a large consumer of energy, the largest federal consumer being the

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[1] Holloman, J. Herbert, *et al.* *Energy Research and Development*, a report to the Energy Policy Project of the Ford Foundation. Cambridge, Mass.: Ballinger, 1975.

Department of Defense, for which special energy reserves are maintained.

Prior to the energy crisis, an overall federal energy policy had not been articulated. After the oil embargo, however, the executive and legislative branches began to focus their efforts on defining some desired energy policy outcomes. In 1973, the Administration defined an adequate and dependable supply of energy as a general policy goal. According to former Secretary of the Interior Rogers Morton, the plan was "to meet the nation's essential needs and assure its prosperity and security in ways which are consistent with natural environmental and social objectives".[1] More specifically, Morton identifies Administration energy policy objectives to include:

1. Increasing domestic production of all forms of energy.

2. Conserving energy more effectively.

3. Striving to meet energy needs at the lowest cost consistent with the protection of both the national security and the natural environment.

4. Reducing excessive regulatory and administrative impediments that have delayed or prevented construction of energy-producing facilities.

5. Acting in concert with other nations to conduct research in the energy field and to find ways to prevent serious energy shortages.

6. Applying scientific and technological capabilities, both public and private, toward utilization of our current energy resources more wisely and developing new forms of energy more rapidly.[2]

Until Energy Research and Development Administration's (ERDA) most recent plan, increased production was given the highest priority; in the new plan, primary emphasis is focused on conservation. Statements by the Nixon and Ford Administrations have stressed the need for reducing energy imports, ending "vulnerability to economic disruption" by foreign energy suppliers, and providing a greater share of the energy needs of the "Free World" from U.S. domestic supplies.[1]

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[1] Morton, Rogers C.B. "The Nixon Administration Energy Policy." *Annals of the American Academy of Political and Social Sciences*, Vol. 410 (November 1973), p. 66.

[2] *Ibid.*, p. 67.

Since the early 1970's the degree to which a "free market" economy is capable of attaining national goals has been a central point of disagreement between the Democratic-controlled Congress and two Republican presidents. The Executive position has essentially been that "the competitive pressures of the free enterprise system could do a better job of ensuring sufficient energy supplies at equitable prices than can the federal bureaucracy".[2] On the other hand, the majority leadership in the Congress has questioned whether such a free market system exists, particularly in the oil and gas industries.

While the Congress has generally accepted the goals outlined by the Executive, it has seriously disagreed with many of the means (public versus private) and methods (market versus government intervention) by which the objectives should be achieved. For example, the Congress has opposed outright deregulation of oil and gas as a means of increasing domestic energy supply. Similarly, presidential plans to restrain energy demand through increased prices have been countered by congressional proposals for mandatory conservation measures and tax incentives for specific conservation targets. Finally, Congress has disagreed with the Administration on the priorities assigned to energy goals. In general, the Democratic majority has attached more importance to domestic economic recovery than to the Administration's desire to reduce dependence on foreign oil.[3]

The policy compromises that have resulted from these divergent viewpoints have focused largely on the organizational modifications necessary to deal effectively with energy policy goals. Reorganization proposals since the early 1970's have had two objectives: consolidation of institutions to increase domestic production (primarily through better coordination or information-gathering activities); and elimination of constraints on production (usually focused on eliminating regulations).

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[1] Bureau of National Affairs. "Energy Reorganization Act of 1974." Energy Users Report, p. 71:7151 (September 23, 1976).

[2] Havemann, Joel. "Crisis Tightens Control of U.S. Energy Production." National Journal Reports, Vol. 7 (April 26, 1975), p. 619.

[3] Gulick, Frances A. "Energy-Related Legislative Highlights of the 93rd Congress and a Comparison of Three Energy Plans Before the 94th Congress." Public Administration Review, Vol. 35 (July/August 1975), pp. 349-54.

Even before the energy crisis, a concerted effort had been made to consolidate energy functions. As early as 1971, the President's Advisory Council on Executive Organization recommended the establishment of a Department of Natural Resources as a solution to the problems of administrative fragmentation. In 1973, the Administration proposed a reorganization plan that would have created a Department of Energy and Natural Resources, ERDA, and a Nuclear Energy Commission. These agencies were to be formed from elements of the Interior Department, the Agriculture Department, the Atomic Energy Commission (AEC), and other agencies.[1] A major aim of this proposal was to break a Congressional deadlock by separating energy research, development, and demonstration (RD&D) functions for other governmental activities related to energy. After the Congress refused to approve this plan, a temporary Federal Energy Office was created by executive order and the Congress was requested to enact legislation establishing a more comprehensive Federal Energy Administration.[2] Congress responded with the Federal Energy Administration Act in May 1974, and the Energy Reorganization Act of October 1974 which dissolve the AEC and create ERDA and the Nuclear Regulatory Commission.

ERDA was created at least in part because the RD&D policy option proved to be the easiest area in which a reorganization accommodation could be reached. Other policy changes have been more difficult to effect. Proposals to legislate emergency powers for the President were delayed, primarily because of controversy over provisions added by the Democratic majority in the Congress concerning windfall profits, environmental standards, and price-rollbacks. Similarly, impasses developed over legislation that would alter industry tax structures, require information disclosures by the private sector, and give government a more direct role in energy exploration and development activities. Conflict has also arisen between the Administration and Congress regarding the federally guaranteed Energy Independence Authority proposed by the President.[3]

U.S. foreign policy responses have also met with limited success. The thrust of American efforts have been to press for the cooperation of oil-importing nations in developing programs to reduce consumption, generate new energy resources, and assure international financial stability. The U.S. has taken the position that only after consuming nations have agreed on such programs can constructive negotiations with the Organization of Petroleum Exporting Countries (OPEC) cartel begin. One concrete result of this policy has been the creation of the International Energy Agency (as an autonomous organization under the direction of the Organization for Economic Cooperation and Development) to coordinate responses to any future disruption of energy supplies by exporting nations. Internationally as well as domestically, however, the most promising area of action appears to be efforts at securing cooperation in the RD&D responses of America's allies.[1]

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[1] Davis, David H. *Energy Politics*. New York, N.Y.: St. Martin's Press, 1974, pp. 185-87.

[2] Fowlkes, Frank J., and Joel Havemann. "President Forms Federal Energy Body with Broad Regulation, Price Control Powers." *National Journal Reports*, Vol. 5 (December 8, 1973), pp. 1830-38.

[3] "Energy Corporation," *Congressional Quarterly*, Vol. 33 (September 27, 1975), p. 2045.

B. State Governments

The range of state agencies participating in the energy policy systems has been increasing, but their roles continue to be limited. Prior to the 1973 energy crisis, energy was generally not a problem for most states. To the extent to which they were involved state government participation was severely constrained by: the inability of state authorities to deal with energy supply markets that were national or international in scope; the inadequacy of traditional state regulatory agencies to cope with complex, non-legal energy problems; and the absence of effective energy policy coordination mechanisms between the federal and state governments.[2] Although the scope of energy supply problems continues to defy easy solution, state governments have reacted to organizational shortcomings by creating new energy councils, committees, and task forces to deal with energy issues and to coordinate policy.

Each of the eight western states included in our study area has such an energy agency in the executive branch of its government. In addition, departments or offices of planning and development, health, environmental protection, and natural resources exist in most of the states. These departments also have a role to play in energy development.

Historically, states have exercised extensive authority over such things as the regulation of facility siting and licensing, the availability of state-owned energy resources for development, and the establishment of prices and rates of production for intrastate energy resources. The opportunities for greater state participation in the energy system, have, in many cases, been enhanced by the energy crisis. Under general federal guidelines, states have been delegated important responsibilities for formulating and adopting water and air quality criteria to meet federal requirements, collecting data upon which to base petroleum allocation regulations, and enforcing conservation restrictions (such as the 55-mile-per-hour speed limit). Moreover, as new energy facilities become larger, they often require special siting procedures that may involve several states or even several regions.[1] However, a major factor constraining such cooperative efforts is the diversity of state energy policy orientations. For example, even within an area as seemingly homogeneous as the Rocky Mountain area, states with similar cultural and political histories may pursue different energy policy objectives.

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[1] Freeman, David S. Energy: The New Era. New York, N.Y.: Random House, 1974, pp. 134-36.

[2] Swindler, Joseph C. "The Challenge to State Regulation Agencies: The Experience of New York State." Annals of the American Academy of Political and Social Sciences, Vol. 410 (November 1973), pp. 106-19. However, the indirect role of states in such areas as water, highways, taxes, reclamation, and occupational health and safety should not be overlooked.

States can be expected to continue to have substantial authority in those areas within which federal legislation is either inadequate or non-existent. Noise impacts of energy development are a case in point. Noise impacts are affected either directly or indirectly by several kinds of federal and state statutes, including those dealing with land use, environmental protection, and noise. The Noise Control Act of 1972[2] leaves substantial implementation authority to states, and its applicability is restricted to noise impacts related to industrial equipment, railroads, and autos. Since federal land-use planning laws are non-existent, noise at a specific energy development site is likely to be controlled by either state land-use laws or local zoning, noise, or land-use rules and regulations.

Efforts to formulate national energy policies have also resulted in major new federal-state conflicts, such as disputes over the kind of controls that should be imposed when western coal is strip mined. Potentially significant contributions to domestic energy supplies have been delayed because energy-rich states have perceived federal regulations as placing immediate costs and risks (largely the hazards of environmental disruption) on the states while reserving possible benefits for the longer term, indefinite future. Legislation to provide compensation for affected states has been one widely discussed solution to this problem.[3]

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[1] Doub, William O. Federal Energy Regulation: An Organizational Study. Washington, D.C.: Government Printing Office, 1974.

[2] Noise Control Act of 1972, 86 Stat. 1234, 42 U.S.C.A. §§ 4901 et seq. (Supp. 1973).

[3] Magida, Arthur J. "Coastal States Seek Changes in OCS Leasing Policy." National Journal Reports, Vol. 7 (February 15, 1975), pp. 229-39.

C. Local Governments

Local governments have generally paid little attention to the need for developing institutions to cope with energy problems, largely because energy has not been much of a local problem in the past. While local administration of zoning ordinances, building codes, and health and sanitation standards can have major impacts on energy development, the importance of these powers is often not fully appreciated. The limitations of local governments often are a result of a lack of technical expertise, inadequate data bases, and a long tradition of decisionmaking which has stressed accommodation with and wide discretionary authority for the private sector.[1] In large part, these limitations for local governments in the West can be attributed to their size and the fact that most have never had to cope with problems associated with rapid growth. At least 131 western communities are expected to be impacted by energy development in the next 25 years. Nearly 90 percent of these communities have a present population of less than 5,000. Moreover, 45 percent have population less than 1,500 and are more than 100 miles from a metropolitan area.[2] These communities have very limited capacities for growth management; only 9 percent have professional planners, 6 percent have full-time city engineers, and 3 percent have city managers.[3]

Because many localities have continued to "deal only with narrowly defined issues, play only a reactive role, and make policy by default,"[4] they have increasingly found themselves following the leadership of federal or, at times, state officials in implementing programs that are critical for the administration of municipalities. (The fuels allocation program is an example.) In fact, local governments have often favored federal leadership as a means of circumventing state governments, viewed as unresponsive to local needs.

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[1] Roberts, Marc. "Is There an Energy Crisis?" *The Public Interest*, Vol. 31 (Spring 1973), p. 27.

[2] Mountain Plains Federal Regional Council, Socioeconomic Impacts of Natural Resource Development Committee. *Socioeconomic Impacts and Federal Assistance in Energy Development Impacted Communities in Federal Region VIII*. Denver, Colo.: Mountain Plains Federal Regional Council, 1975.

[3] *Ibid*.

[4] See Aron, Joan B. "Decisionmaking in Energy Supply at the Metropolitan Level: A Study of the New York Area." *Public Administration Review*, Vol. 35 (July/August 1975), pp. 340-45.

Examples of federal-local conflicts over energy policy are easy to find. National energy policies that have provoked the greatest local resistance include the mandatory fuel allocation program, which has led city governments to press for increased supplies by lobbying nationally through such organizations as the League of Cities and the National Governors' Conference.

D. Intergovernmental Associations[1]

A variety of intergovernmental associations also participate in energy policymaking. These now include associations among many of the eight western states and combinations of local government units, such as associations of county governments.

Institutional arrangements among states in the western U.S. reflect the range of similar and/or common problems faced by states within the region. In general, similarities include a widespread concern about the regional costs of energy development undertaken primarily for the benefit of other regions of the country and the large amounts of federally owned lands over which the states have little or no control. However, regional institutional arrangements also reflect and are sometimes inhibited by important differences and conflicts among the states, including very different interests and priorities with regard to energy resource development and occasionally intense competition for federal funds, industrial development opportunities, and water resources. This complex set of shared and competing problems [illegible] interests sets the context within which selected regional parties-at-interest to energy resource development are discussed below.

1. River Basin and Water Availability Agreements

One category of interstate parties-at-interest is river basin and/or water availability agreements that have been negotiated to deal with issues related to both the availability and quality of western water supplies.

The Colorado and Missouri River Basins receive primary emphasis in this study. Two interstate compacts deal with the Colorado: the Colorado River Compact of 1922, and the Upper Colorado River Basin Compact of 1948. Two other compacts deal exclusively with the Missouri: the Belle Fourche River Compact of 1943, and the Yellowstone River Compact of 1951. The Colorado River Basin is also affected by an international treaty with

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[1] Since this section was written, a new multi-state organization has been approved by western governors. This new organization, which will absorb many of the existing organizations, will be described in a later report.

Mexico.[1] These compacts and the Mexican Water Treaty are discussed in Section 14.2.

In addition to these agreements among states in the region, intergovernmental relations concerning water are affected by the Water Resources Planning Act of 1965.[2] Title II of this act established the authority for river basin commissions which bring together the representatives of the states and of federal agencies with an interest in river basin development. State members are appointed by agency or department heads. Although headed by a chairman appointed by the President, these commissions are joint in the sense that the right of both the federal and state governments are limited by the rights of the other.[3]

River basin commissions have no operating or management authority. Thus, they serve primarily as forums to facilitate planning for development of the river basins. Several commissions have been established in the water resource regions, which include all or part of one or more of the eight western states.

2. Economic Development Commissions

Title V of the Public Works and Economic Development Act of 1965 established five regional organizations, modeled after the

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[1] Colorado River Compact of 1922, 42 Stat. 171, 45 Stat. 1064 and declared effective by Presidential Proclamation, 46 Stat. 3000 (1928); Upper Colorado River Basin Compact of 1948, 63 Stat. 31 (1949); Belle Fourche River Compact of 1943, 58 Stat. 94 (1944); Yellowstone River Compact of 1950, 65 Stat. 663 (1951); and Treaty between the United States of America and Mexico Respecting Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, February 3, 1944, 59 Stat. 1219 (1945), Treaty Series No. 994. In the 1922 Compact, states in the "Upper Division" are Colorado, New Mexico, Utah, and Wyoming; states in the "Lower Division" are Arizona, California, and Nevada.

[2] Water Resources Planning Act of 1965, 79 Stat. 244, 42 U.S.C.A. §§ 1962 *et seq.* (1974).

[3] Derthick, Martha. *Between State and Nation: Regional Organizations of the United States.* Washington, D.C.: Brookings Institution, 1974, pp. 138-41. Derthick's assessment of Title II commissions suggests that state participation can be attributed primarily to defensive reasons, specifically to be able to present and define their interests. She also finds less gubernatorial participation here than in the Title V economic commissions, largely because fewer federal funds are transferred to the states through the river basin commissions.

Appalachian Regional Commission.[1] Their purpose is to increase federal-state cooperation in eliminating interregional economic disparities. The Four Corners Regional Commission (comprised of Arizona, Colorado, New Mexico, and Utah) was the first of these to be established in the West. The second in the West, the Old West Regional Commission (comprised of Montana, Nebraska, North Dakota, South Dakota, and Wyoming), was established in 1972.

These commissions were initiated and are largely funded by the federal government, although some matching funds come from the states. The granting legislation provided for no state control over federal agencies; hence, activities are usually confined to coordinated regional economic plans and related "action programs". However, Title V Commission expenditures average under $5 million per year for these programs.

The Four Corner Region is populated by less than two million inhabitants, many of whom are Indian. Per-capita income is 30 percent below the national average. The Commission's development plan identified employment and the elimination of "job gap" problems as its major goals. Specific programs have been undertaken to: improve highways, health, and education facilities; promote new agricultural development; increase exploitation of materials; and improve the attractivness of the area for industrial development.

The Old West Regional Commission was formed to help alleviate low per-capita income, increase what had been a low economic growth rate, and reverse the out-migration of skilled and educated residents. Its development plan lists five areas of principal concern: agriculture and natural resources, transportation, human resources, industrial and capital resources, and energy resources.

It has been suggested that Title V Commissions have not developed as originally expected.[2] A survey of state participants in Title V Commissions suggests that they have existed in limbo with respect to other governmental and regional institutions, significantly reducing any influence they might exert on regional development. Moreover, their primary role now appears to be to serve as a mechanism for channeling federal funds to the states.[1]

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[1] Public Works and Economic Development Act of 1965, 79 Stat. 552, 42 U.S.C.A. §§ 3121 *et seq.* (1973).

[2] Derthick, Martha. *Between State and Nation: Regional Organizations of the United States*. Washington, D.C.: Brookings Institution, 1974.

3. Western Governors Regional Energy Policy Office[2]

The Western Governors Regional Energy Policy Office (REPO) was formally established in July 1975 for the purpose of representing 10 western states in their relationship with the federal government in matters concerning energy resource development.[3] In addition to providing liaison with federal agencies, the governors proposed that the organization be used as an information clearinghouse and an interstate coordination and communication mechanism.

Clear differences exist among REPO members regarding the organization's role in regional-federal relations, its authority, and the membership advantages accruing to individual states. Members also disagree on the relative position to be taken by REPO with respect to environmental versus developmental concerns. Since both concerns are important to various member states, it was agreed that both were to be represented in organizational activities. This was considered an incentive for more states to accept membership. Thus, REPO represents a loose coalition among states whose interests are very diverse, ranging from the preservation of the environment, land, or lifestyles to increasing fuel supplies and/or gaining the economic benefits of energy development.

REPO members have also disagreed over the scope of political authority the organization should exert. REPO's activities suggest that this issue has been resolved by its promotion of the interests of individual states as well as common regional interests.

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[1] Derthick, Martha. Between State and Nation: Regional Organizations of the United States. Washington, D.C.: Brookings Institution, 1974, p. 132. There are other regional organizations devoted either exclusively or primarily to economic development. These will be introduced into the analysis during the next 2 years when their role is important enough to warrant their being considered.

[2] REPO is one of the existing interstate organizations that will be absorbed by the newly established multistate organization mentioned earlier.

[3] The 10 states are Arizona, Colorado, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Utah, and Wyoming.

In both cases, REPO is not intended to exercise authority superseding that of its members.[1]

4. Federation of Rocky Mountain States[2]

The Federation of Rocky Mountain States was chartered as a private, non-profit corporation in 1966 by the governors of Colorado, Montana, New Mexico, Utah, and Wyoming. (Arizona, Idaho, Nevada, and North and South Dakota also participate in some of the Federation's programs.) In addition to the governors and their representatives, participants in the Federation include many of the business, industry, education, and research leaders of the region.

The purpose of the Federation is to provide a forum for coordinating regional planning, primarily with respect to policies for maintaining the quality of life for residents of the region while improving their social, cultural, and economic well-being. Two-thirds of the organization's funding has come from the federal grants; the other third has come from state contributions and private member dues. The Federation's activities are organized and administered by councils composed of representatives from government, business, education, and regional interest groups. The councils' activities are directed toward natural resource development, market development, transportation, human resources, telecommunications, housing and community development, and the arts and humanities.

To date, the most significant product of the Federation related to western energy development is a report produced by its Natural Resources Council entitled Energy Development in the Rocky Mountain Region: Goals and Concerns.[3] This report contains two "proposed regional energy policy statements". The first statement strongly emphasizes conservation as a foundation, not an alternative, to both long- and short-term national energy policies, and the second statement calls for substantive roles for state and local governments (as opposed to the Federation) in the development of national energy policies.

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[1] For an elaboration of these issues related to the formation of REPO see: Hayes, Lynton. Energy Policy in the American West. Ph.D. Dissertation, University of Indiana, 1975, pp. 94-150.

[2] The Federation will also be absorbed by the new multistate organization. In fact, the Federation and its Executive Director, Phillip M. Burgess, will have the lead role in establishing this new organization.

[3] Federation of Rocky Mountain States. Energy Development in the Rocky Mountain Region: Goals and Concerns. Denver, Colo.: Federation of Rocky Mountain States, 1975.

The Federation appears to have been successful in investigating and developing regional positions on a wide variety of issues that are important to member states. In doing so, it has served primarily as a link between governors and private industries. It also has been financially successful, having received over $11 million in non-member funds since 1972.[1]

With respect to regionalism and interstate energy relations, the Federation has, with the concurrence of the governors of its member states, taken strong stands on some issues. Federation policy positions reflect a strong commitment to promote the interests and extend the authority of member states rather than enlarge its own role. Thus, the Federation represents one forum by which states of the region may coordinate activities and represent their interests to other interested parties, such as the federal government.

5. Conclusions About Intergovernmental Associations

This review of regional institutions has necessarily been highly selective. Those discussed represent only a few of the more than 130 western multi-state groups now in existence.[2] However, some tentative conclusions can be drawn from the activities of the selected organizations discussed above. Clearly, they are not designated or constituted to create a supra-state organization with regulatory or administrative powers over the states. Indeed, these organizations have no formal authority over member states. The basis for most of the regional associations is a recognition by the members of common problems, a common adversary (normally the federal government), and/or common values. The associations are generally designed to further mutual interests by facilitating the exchange of information, coordinating actions and reactions, and providing planning services. In some cases, regional organizations serve as conduits for the dispersion of federal grant funds to the states and play little or no role in regional planning for energy development.

Strong state individualism, variations in state priorities related to energy development and environmental concerns, and competition for natural resources and federal funds strongly influence the character of interstate relations. Hence, organizations designed to further mutual interests characteristically are concerned primarily with increasing the power of individual member states. Acting as a collective voice for the general interests of western states is seen as a secondary or tertiary objective for most of the parties to the various agreements.

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[1] This $11 million includes the major federal funding support mentioned earlier.

[2] This is a preliminary finding of a 10-state task force of the Western Governors' Conference, Teton Village, Wyoming, September 16, 1976.

13.3.2 Private Participants

The organizational and policy changes in the public sector have been paralleled by modifications in the energy industry and by increased participation of other private parties-at-interest. This section examines the role of private sector participants, emphasizing energy companies and major environmental interest groups.

A. The Energy Industry

The most significant change in the energy industry in recent years has been the growth of conglomerates which develop multiple resources. Especially important have been the acquisitions in the last decade by the oil industry of coal and uranium resources. Entry by these new "energy companies" into multiple fuel areas has generally been accomplished by acquiring energy reserves or production facilities, or through joint-venture agreements.[1]

These tendencies toward integration, coupled with recent (1973-74) increases in energy prices and industry profits (particularly in some sectors of the petroleum industry), have created a political issue over the role of energy firms in public policy. Questions have been raised as to competitiveness, attentiveness to the "public interest", and the type and degree of government control over the energy industry. One view of the industry argues that "present market structures are not monopolistic"[2] and that assuming they could become monopolistic is a "naive exaggeration" of the industry's effectiveness as a political pressure group.[3] However, another view is that the industry wields "exceptional political power" in the pursuit of goals which often are not congruent with the "public interest".[4]

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[1] Duchesneau, Thomas D. Competition in the U.S. Energy Industry, a report to the Energy Policy Project of the Ford Foundation. Cambridge, Mass.: Ballinger, 1975.

[2] Ibid., p. 178.

[3] Gordon, Richard. "Mythology and Reality in Energy Policy," Energy Policy, Vol. 2 (September 1974), p. 195.

[4] Ford Foundation, Energy Policy Project. A Time to Choose: America's Energy Future. Cambridge, Mass.: Ballinger, 1974, p. 230. Given industry's importance as a participant in western energy resource development, considerable attention will be devoted to identifying industry's role in the policy analyses which are to be the central focus during the remainder of this study.

B. Environmental Interest Groups

Environmental interest groups represent the best known of the new participants in the energy system. In terms of organization these groups often do not have professional staffing or large memberships. Of the more than 3,000 organizations in the U.S. concerned with the environment/energy interface, only a few of the 250 national and regional groups have the resources to undertake major policy initiatives. For example, only about 20 environmental protection groups maintain offices in Washington,[1] and even fewer organizations have specifically focused their activities on the environmental aspects of energy policy.

The most influential environmental groups are the general public, or "citizens" groups, including the Sierra Club, Audubon Society, Friends of the Earth, and Environmental Defense Fund, which have dedicated themselves to the achievement of such broad sociopolitical goals as the "restoration and preservation of the earth's resources".[2] These groups have, for the most part, moved beyond a traditional emphasis on resource conservation to focus on the more general problems associated with the environment, both as a source of raw materials needed to generate energy and as a depository of the pollution resulting from the production and use of energy. Another group, the Center for Law and Social Policy, has become active in energy affairs, often handling legal cases on behalf of previously unrepresented groups. The Center's activities are broad-based, national in scope, and include operating a clinical law program and a coal mine safety project.

To date, the courts have proven the most viable alternative for environmentalists when neither the economic market mechanisms nor the legislative-administrative political system has responded to their concerns. As Michael McCloskey, conservation director of the Sierra Club, characterized this activist strategy, "We will sue and sue and sue".[3] Examples of legal actions by citizens' groups are the suits against Consolidated Edison's planned pump-storage electric generation plant at the Storm King Mountain preserve[1] and against Environmental Protection Agency (EPA) orders to relax air quality standards.[2] In the later case, the litigation forced EPA to develop specific guidelines for protecting the nation's clean air areas from significant deterioration of their air quality.

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[1] Freeman, David S. Energy: The New Era. New York, N.Y.: Random House, 1974, pp. 134-36.

[2] The Onyx Group. Environment U.S.A. New York, N.Y.: R.R. Bowker, 1974, p. 80.

[3] Garvey, Gerald. "Environmentalism Versus Energy Development: The Constitutional Background to Environmental Administration." Public Administration Review, Vol. 35 (July/August 1975): pp. 328-30.

C. Other Interest Groups

A variety of other interest groups are likely to become participants in the energy policy system as they begin to be indulged or deprived by development. For example, labor unions (such as the United Mine Workers and the Oil, Chemical, and Atomic Workers International) compose one category of participants likely to be interested in several energy-related issues. (Section 13.4 discusses labor interests in energy policymaking.)

Both Indian tribes and other organized Indian groups are beginning to develop as powerful parties-at-interest because substantial energy resources are located on tribal reservations and Indian water rights can significantly influence the allocation of limited water supplies for energy resource developments in the West. Although the legal boundaries of Indian water rights are still being determined, the reservation doctrine can be interpreted as giving Indians substantial control over surface waters that border on or pass through their reservations. (This issue is discussed in more detail in Chapter 14.) Energy development in the western U.S. is likely to affect many of the 75 reservations in the eight states. However, by virtue of their proximity to critical water resources, the most heavily involved tribes are likely to be the Coeur d'Alenes, Crow, Hualapai, Navajos, and Northern Cheyenne. Groups such as the Council of Energy Resource Tribes, National Congress of American Indians, American Indians for Indian Opportunity, and Native American Rights Fund are also likely participants in energy policymaking.

Agricultural interest groups have also begun to participate in energy policymaking. A national level example is the Soil Science Society of America which is concerned with the relationship of energy to agriculture and agronomy. The Utah Association of Soil Conservation Districts, concerned with planning and programming conservation activities (particularly on private land), is an example of a regional agricultural interest group.

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[1] Scenic Hudson v. Federal Power Commission, 354 F.2d 608 (2d Cir. 1965), *cert. denied*, 384 U.S. 941 (1966).

[2] Sierra Club v. Ruckelshaus, 344 F. Supp. 253 (D.D.C. 1972), *affirmed*, 4 ERC 1815 (D.C. Cir. 1972), *affirmed sub nom.*, Fri v. Sierra Club, 412 U.S. 541 (1973).

D. Interstate Interest Groups

Just as public sector participants from associations on an interstate or regional basis, groups from the private sector form coalitions to further the interests of several states at once. As noted above, the Federation of Rocky Mountain States includes private sector members, largely affiliated with industry, from several western states. Other interstate, non-governmental interest groups include the Western Systems Coordinating Council (an association of utilities) and the National Association of State Departments of Agriculture (whose energy interests are to coordinate state agri-business energy needs with federal fuel allocation policies).

13.4 ENERGY POLICY SUBSYSTEMS

The energy policy system participants discussed in the previous section are involved to varying degrees in a set of policy subsystems that have developed around coal, gas, and electricity.[1] The section sketches the industry, labor, and government interactions in each of these fuel subsystems.

13.4.1 The Coal Policy Subsystem

Historically, coal companies have had the reputation of being the least efficiently organized, economically poorest, and "worst functioning industry in the country".[2] However, this has not kept them from developing powerful industry organizations such as the National Coal Association. Also, the industry has recently been receiving large infusions of capital and expertise, primarily as a consequence of the formation of energy conglomerates. Coal has generally been the energy resource least subject to federal government control, but this has also changed in recent years with the passage of the 1969 Coal Mine Health and Safety Act and the introduction of federal regulatory agencies such as the Mining Enforcement and Safety Administration (MESA).

The most striking characteristic of the modern coal industry is the degree to which production is increasingly owned by corporations whose primary business is not coal. In 1973, two of the three largest coal producers, five of the top ten, and seven of the top fifteen were owned by oil conglomerates.[1] This trend has meant that money and administrative skills have become available to large portions of the coal industry, long handicapped by low worker productivity, disputes over the environmental consequences of strip mining, and chronically poor relations with the United Mine Workers (UMW). As a result, advertising, lobbying, and political campaign contributions, which the coal industry previously could not afford, are being increasingly used to promote industry viewpoints.

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[1] The nuclear energy industry has also developed a policy subsystem important to overall energy policymaking. Since, except for uranium mining and milling, nuclear energy is beyond the scope of this technology assessment, the nuclear subsystem is not discussed here.

[2] Parker, Glen L. The Coal Industry: A Study in Social Control. Washington, D.C.: American Council on Public Affairs, 1940, p. 15.

Because the coal industry's political orientation and influence has, in the past, been directed primarily at state governments (until the late 1960's, most coal regulatory functions were implemented at the state level), coal firms do not have the extensive history of contact and interaction with federal regulators that oil and gas producers do.[2] In fact, coal has had the fewest links to federal agencies and the least research, development and demonstration (RD&D) at the national level.

The current major federal interests in the coal policy subsystem are focused on environmental, health, and safety programs. Environmental issues hinge on two problems: surface mining and air pollution. Enforcement of strip mining and reclamation regulations is divided between the Department of the Interior and state governments. Air quality standards related to coal combustion are promulgated by the Environmental Protection Agency and implemented by the states. Federal control over health and safety aspects of coal development has been more extensive; MESA and the Bureau of Mines have pre-empted the enforcement of standards in this area.[3]

Among the professional associations that represent the coal industry at the national level, the National Coal Association (NCA) is the most important. The NCA is affiliated with the Coal Exporters Association which is an important organization in U.S. coke and coal trade. Other major industry organizations are the Bituminous Coal Operators Association, composed of the major operators (and industry representative in labor contract negotiations) and the National Independent Coal Operators Association, which represents the smaller firms. Some coal interests are also articulated by more general business organizations, such as the American Mining Congress and the American Iron and Steel Institute.[1]

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[1] Ridgeway, James. The Last Play. New York, N.Y.: E.P. Dutton, 1973, p. 18.

[2] Ford Foundation, Energy Policy Project. A Time to Choose: America's Energy Future. Cambridge, Mass.: Ballinger, 1974, p. 230.

[3] University of Oklahoma, Science and Public Policy Program, Fossil Fuel Research Team. The Coal and Oil Shale Resource Development Systems: An Interim Report. Norman, Okla.: University of Oklahoma, Science and Public Policy Program, 1974, pp. 202-204.

Of all the energy resources, coal has been most influenced by labor union participation. The UMW has dominated the history of coal labor since the 1870's, although its influence has fluctuated from a low point during the 1930's (when membership fell from a 1920 peak of over 750,000 to only 75,000) to a high point during the period of union "autocracy" and militancy in the 1940's.[2] Since 1945, the UMW has modified what many view as its earlier radical stance and has negotiated agreements with the Bituminous Coal Operators Association to control markets, production, and employment levels. However, as the industry has become more mechanized and diversified, many mining jobs have been lost to machines, to other unions, and to non-union workers. Between 1947 and 1973, more than 300,000 coal-mining jobs ceased to exist, and the current workforce of 150,000 men includes over 35,000 non-union personnel.[3] In addition, the UMW has entered an era of competition with the International Union of Operating Engineers (IUOE), which operates the strip-mining equipment used in most western coal operations. About 90 percent of the UMW membership works in the underground mines of the East, so any move away from underground coal extraction techniques to stripping in the West would enable operating companies to contract with the IUOE on what some observers believe would be more favorable terms than the UMW offers.[4] Despite these threats to UMW control of coal labor, the union continues to be the most significant labor force in the entire energy policy system, as demonstrated by its ability to gain passage of such important standards as the 1969 Coal Mine Health and Safety Act provisions establishing compensation for "black lung" disease victims.

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[1] National Coal Association. Bituminous Coal Facts 1972. Washington: National Coal Association, 1972, pp. 40-47; and Ridgeway, James. The Last Play. New York, N.Y.: E.P. Dutton, 1973, p. 18.

[2] Velie, Lester. Labor U.S.A., New York, N.Y.: Harper and Brothers, 1958, pp. 142-43.

[3] Hoerr, John. "Coal and the Mine Workers." Atlantic, Vol. 235 (March 1974), p. 20.

[4] Noone, James A. "Administration Joins Opposition to Strip Mining Bill." National Journal Reports, Vol. 6 (June 15, 1974), p. 888.

13.4.2 The Oil Policy Subsystem

The oil industry is the preeminent industry in the energy policy system. This industry probably has the most influence on its policy subsystem because of the strength of its individual companies, industry associations such as the American Petroleum Institute (API), and policy advisory bodies such as the National Petroleum Council (NPC).

As the energy industry with the greatest economic resources at its disposal (in 1972, 23 oil companies each had revenues of $250 million or more), the oil industry is easily able to afford the costs associated with political involvement.[1] This economic position has also allowed the industry to meet most labor union demands, thus minimizing manpower problems.[2]

Other structural factors that have worked to the advantage of the petroleum companies are their high degrees of vertical and horizontal integration. At least 18 oil companies explore for, produce, refine, transport, and market crude oil, and many oil companies also own and produce natural gas, coal, and/or uranium or influence the development of those resources.[3]

These factors (plus the fact that seven international oil companies hold a dominant world leadership position in the industry) have led to a significant community of interest among oil firms on political matters, although differences between the integrated "majors" and the more specialized "independents" have somewhat weakened this consensus on such controversial matters as the removal of oil price controls. Finally, the oil industry owes some of its success in influencing policy to the national impact it can achieve as a result of a fairly broad geographical dispersion of industry components.

A major avenue by which the petroleum firms exercise policy influence is lobbying. Industry associations such as the API (composed of 350 member companies) gather data, undertake research, and present policy recommendations to public officials at every level of government, as well as to the media. An estimated $10 million per year is spent for lobbying payrolls by the

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[1] Gray, John E. *Energy Policy: Industry Perspectives*. Cambridge, Mass.: Ballinger, 1975, p. 81.

[2] Not all of the industry is unionized. Most unionized are refining and petrochemicals; least unionized is offshore exploration and production.

[3] Gray. *Energy Policy*, pp. 15-16.

60 oil and gas organizations in Washington alone.[1] (API's 1974 budget was in excess of $15 million.) The "oil lobby" has, in fact, expanded to such an extent that foreign governments have begun to engage their own Washington lobbyists to "monitor" petroleum policy developments.

Closely related to the lobbying function is the use of campaign contributions as a policymaking tool by the oil industry. For example, over $5 million was supplied to the 1972 election campaign by oil industry officials and stockholders.[2]

Oil industry positions are advanced by the government-sponsored NPC. Composed of members from industry associations (such as API, the Independent Petroleum Association of America, representatives of the major oil companies, and other private oil interests), the NPC serves as an advisor to the Secretary of the Interior and has access to the Congress and to a broad range of energy regulatory agencies.[3]

Finally, the Interstate Oil Compact Commission performs a coordinating role between these oil-producing states and the industry.

These apparent advantages are balanced somewhat by the fact that the oil subsystem is very complex, and petroleum and its products are regulated at every level of government. In addition to the Interior Department's control of federal leasing and disposal policies, oil resources are regulated at the national level by the Federal Energy Administration, which: operates the oil allocation, conservation, and imports programs; coordinates planning and data-gathering activities; and develops executive-branch policy alternatives. Also, each state that contains producing oil fields within its boundaries has regulatory authority over those operations.

Labor has not been a major factor in the oil policy subsystem. The major labor organization in the oil and natural gas subsystems is the Oil, Chemical and Atomic Workers International Union (OCAW), which has approximately 200,000 members among the industry's blue-collar workers.[1] Although limited in its impact on the petroleum subsystem by the relative prosperity of the entire industry and the traditionally weak unionization history of many oil-producing states, the OCAW has sought to strengthen its role since the energy crisis. In an attempt to gain more political leverage by expanding its membership, the OCAW in 1973 launched an effort to organize the white-collar sectors(scientists and engineers, for the most part) of the oil, chemical, and atomic energy industries.[2] The union has also taken a more militant stand regarding industrial relations; strikes against oil companies in 1973 sought union authority over such traditional management spheres as health and safety conditions for workers.[3]

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[1] Freeman, David S. *Energy: The New Era*. New York, N.Y.: Random House, 1974, p. 179.

[2] Smith, A. Robert. "No Shortage of Energy Lobbying." *Bulletin of the Atomic Scientists*, Vol. 30 (May 1974), p. 12.

[3] Davis, David H. *Energy Politics*. New York, N.Y.: St. Martin's Press, 1974, p. 79.

13.4.3 The Gas Policy Subsystem

The natural gas subsystem is closely related to the oil subsystem because many gas producers are, in fact, oil companies. But unlike the oil industry, most natural gas companies are not characterized by vertical integration. They are frequently complex organizations because most gas producers also produce oil and many gas distribution companies also sell electricity. The result is an intricate industry ownership pattern in which a few large petroleum companies and a plethora of relatively small independent gas producers make up the production sector, independently owned companies control transmission, and both investor-owned and publicly owned businesses link the transmission system to consumers. Clearly, this diversity of ownership does not encourage the community of interests that characterizes the oil industry, nor does it simplify regulation.

At the apex of the governmental authority in the gas policy system is the Federal Power Commission (FPC), which is responsible for the regulating of pipeline construction, the pricing of interstate gas, and the allocation of gas supplies to utilities. However, of the approximately 30,000 domestic oil and gas producers, only one in ten is subject to the regulations of the FPC. Federal law requires that separate firms transport and distribute the product; the transmission companies are regulated much more stringently than the production companies. There are over 100 regulated interstate gas pipeline companies (of which about 30 are considered "major") and more than 1,500 gas distribution firms.[1] Other governmental controls are exerted on gas companies by the Department of the Interior, which has control of leasing, and by state governments, which have control over their own producing areas.

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[1] Environment Information Center, Energy Reference Department. Energy Directory Update. New York, N.Y.: Environment Information Center, 1976, Part 03, p. 103.

[2] "A Union for Industrial Scientists?" Science, Vol. 181 (September 14, 1973), p. 1030.

[3] Shapley, Deborah. "Shell Strikes: Ecologists Refine Relations with Labor." Science, Vol. 180 (January 12, 1973), p. 166.

Foremost among the representatives of the natural gas industry is the American Gas Association (AGA), an organization of distributors and transporters. The AGA is the most important natural gas industry association because it is a primary source of data for the FPC on such topics as gas reserves. The AGA also performs an important industry RD&D function. Normally the consumer-oriented American Public Gas Association, which is made up of city-owned utilities operates in opposition to the AGA.[2] The major gas pipeline companies are represented by the Interstate Natural Gas Association. In addition, both the API and the NPC often act as spokespersons for the gas industry.

Labor participants in the gas subsystem closely parallel those discussed in the oil subsystem.

13.4.4 The Electricity Policy Subsystem

The electric utility industry, perhaps the most complex and diverse in the entire energy policy system, is composed of both investor-owned and public companies. The approximately 275 investor-owned firms, which are generally large and integrated, produce over 70 percent of the nation's electricity, while the 2,900 public utilities, which are mostly smaller and more specialized, account for slightly more than 20 percent of production.[3] One result of the extreme diversity of the firms included within these categories (the private sector includes both independents and subsidiaries of holding companies, nonfederal systems, and rural cooperatives) has been the absence of any community of interest in the electric power industry. However, the electric companies do have certain advantages as participants in the energy systems. Electric utilities comprise the largest American industry in terms of total assets, and require more annual investment than any other industry.[4] In addition, electricity is produced everywhere in the nation; there are no "electricity states" as there are "coal states" and "oil states". Finally, as the electric utility industry's position is strengthened by the politics of resource scarcity and a mushrooming demand for electric power, electric companies are gradually improving their lobbying activities, their interactions with government, and their RD&D capabilities.

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[1] Gray, John E. *Energy Policy: Industry Perspectives*, a report to the Energy Policy Project of the Ford Foundation. Cambridge, Mass.: Ballinger, 1975.

[2] Davis, David H. *Energy Politics*. New York, N.Y.: St. Martin's Press, 1974, p. 109.

[3] Gray. *Energy Policy*, p. 20.

[4] Ford Foundation, Energy Policy Project. *A Time to Choose: America's Energy Future*. Cambridge, Mass.: Ballinger, 1974, p. 255.

Although the electric utilities have developed few powerful industry-wide associations that represent industry positions to government, bodies such as the Edison Electric Institute (an industry trade association) do exchange technical, operational, and marketing data and coordinate electric power company views with both public and private interests. Cooperation between the industry and government in RD&D policy is promoted by the Electric Power Research Institute.

While electricity generation is regulated at the federal level by the FPC, state governments have the primary regulatory role in siting generation plants, setting the rate structures for utilities, and initiating intrastate cooperative arrangements. The FPC authorizes the licensing of hydroelectric facilities and controls prices of interstate sales of electricity but plays only a coordinating role in the encouragement of the formation of regional electric reliability councils and the development of pooling arrangements.[1] There is no significant labor union indigenous to the electric power industry.

13.5 CONCLUSIONS

Two conflicting conclusions may be drawn from this description of the energy policymaking system. First, pressure is growing for the development of more rational and comprehensive national energy policies. This pressure is reflected in the recent efforts to establish national energy goals and objectives and is based on the desires of political decisionmakers to appear rational. In addition, a wide range of interest groups are demanding that policymakers take a more comprehensive approach to policymaking, including a recognition that a broad range of interests are affected by policies made ostensibly to deal only with energy.

Countering this drive, however, are a number of other factors that make such rational comprehensiveness difficult at best. The two most important of these factors, as implied in the above description of energy institutions, are resource scarcity and the complexity of the energy policy system. This system, composed of fuel subsystems organized around coal, oil, natural gas, and electricity, suffers from all the problems associated with pluralism and fragmentation. Pluralistic politics requires that often difficult to achieve compromises be worked out among competing interests, compromises which governmental institutions with fragmented and overlapping responsibilities and *ad hoc* modes of operation are often ill-equipped to handle. Resource scarcity, resulting from the depletion of finite energy sources and an artificially imposed oil embargo, has intensified each of these difficulties by terminating the long history of stability which had characterized the energy policy system or, perhaps more accurately, the energy policy subsystems.

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[1] Breyer, Stephen G., and Paul W. MacAvoy. *Energy Regulation by the Federal Power Commission*. Washington, D.C.: Brookings Institution, 1974, pp. 89-121.

Until the 1973 embargo, the resource subsystems were relatively self-contained decisionmaking communities, each with a fairly stable set of participants and decisionmaking procedures. This is not to say that decisions in these subsystems were at all centralized or characterized by comprehensive planning. In fact, each resource development subsystem had its own unique pattern of problem solving that permitted it to cope with situations in which goals, alternatives, consequences, and even the problems were often undefined. Resource scarcity, and the resulting instability it created in these already complex resource subsystems, increased the problems of pluralism by adding uncertainty to every energy decision. Groups whose interests were either adversely affected or visibly threatened began immediately to demand the right to participate in the policy process. Whether the group represented farmers seeking larger fuel allocations or East Coast states fearful of the consequences of offshore development of oil, the usual group strategy was to seek governmental intervention. These pressures on political institutions accustomed to assuming only limited authority over energy sources multiplied the problems of fragmentation.

After 1973, the federal government increasingly sought to develop energy agencies better able to respond to interest groups who either did not understand the established decisionmaking procedures or did not subscribe to them. The failures of such bodies as the National Energy Office and the Energy Policy Office in the early days of the energy crisis signaled the breakdown of traditional incremental energy policymaking. Their early attempts to maintain national energy policy as the sum of the subsystems through small modifications in the modes of operation gave way under the pressures of resource scarcity politics and participation demands by new groups. The resulting system instability has produced uncertainty and conflict because the absence of stable procedures have made distinctions between the roles of the public and private sectors difficult to delineate and explain.

One result of the interaction of institutional complexity and resource scarcity has been that a broader range of issues are acting as constraints or obstacles to increasing domestic energy supply. These constraints are essentially of two types: disputes over the distribution of costs and benefits associated with developing resources known to be available (as is the case in the development of western energy resources); and uncertainty regarding availability of resources because the technologies or processes for producing them are unproven. Scarcity has added the uncertainty of the second type to the political issues of the first type; that is, before the energy crisis, each of the fuel communities shared at least some minimal consensus concerning what resources were available. For example, in the coal subsystem the choices were understood to be between various coal regions and mining techniques. The major factors on which to base choices were who would enjoy the benefits and who would pay the costs of such development. To this traditional focus on the benefits and costs of alternatives for various participants (or what has been termed the "rules of the game") has been added substantive uncertainty as to the commercial feasibility of new technological options, as well as concern as to their social and environmental impacts. It is within this context of uncertainty, scarcity, and constraints to domestic energy production that several policy issues are discussed in Chapter 14.

CHAPTER 14

SELECTED PROBLEMS AND ISSUES

14.1 INTRODUCTION

This chapter discusses several categories of problems and issues arising as a consequence of western energy resource development. Each of these discussions was prepared to provide members of the Science and Public Policy-Radian interdisciplinary research team with background information for the more extensive policy analyses on which the study will now focus. Neither the order nor the length of presentation should be viewed as reflecting the relative importance of these problems and issues.

During the remainder of the project, policy analysis will be extended to include the systematic identification and analysis of problems and issues based on the results of our impact analyses. The analysis of these problems and issues will include the identification of participants, institutional arrangements, and existing laws and regulations, and the identification, evaluation, and comparison of alternative policies and implementation strategies. These analyses will be described in detail in the work plan for completing the project. (See Chapter 5).

The following sections contain preliminary background information on problems and issues in seven categories: water availability and quality, reclamation, air quality, growth management, housing, community facilities and services, and Indians.

14.2 WATER

14.2.1 Introduction

Water concerns are among the most visible and politically charged of all the problems and issues that have been identified and discussed in connection with energy development in the western U.S. This is readily understandable because so much of the energy-rich West is water-poor. Competition for water and a concern for its quality are not new. In fact, the existing complex mix of appropriated rights, interstate compacts, court decisions, and unanswered questions (such as those concerning prior rights and beneficial uses) are largely a product of competition for a scarce and often inadequately defined resource. Thus, energy developments being proposed for the region do not create new water problems so much as exacerbate existing ones.

In the past, policymakers have generally tried to resolve western water problems by adding to the already complex legal rights system or, in some cases, by promoting technological fixes. The first approach is illustrated by various interstate compacts and court cases; weather modification and desalinization projects illustrate the second. These kinds of problems and issues affect energy resource developments but are not peculiar to them. But energy resource developments do directly result in several other major problems and issues, some of which are discussed in the following sections.

14.2.2 Water Availability

A. Surface Water

The two major rivers affected by the energy resource developments being considered in this study are the Colorado and Upper Missouri. Waters in the Colorado were divided between Upper and Lower Basin states by the Colorado River Compact of 1922, which guaranteed 7.5 million acre-feet per year (acre-ft/yr) to the Lower Basin.[1] The Water for Energy Management Team of the Department of the Interior (DOI) estimates that a total of 8.25 million acre-ft/yr must be released to the Lower Basin to satisfy the Compact requirements and to meet the 1.5 million acre-ft/yr obligated to Mexico in the Mexican Water Treaty of 1944.[2] Given the estimated in-stream flow of the Colorado River, this leaves the Upper Basin states an estimated 5.25-6.3 million acre-ft/yr[1] to apportion among themselves under the formula they established in the Upper Colorado River Basin Compact of 1948.[2] This formula provides 50 thousand acre-ft/yr for Arizona (a Lower Basin state) with the remainder being allocated on the basis of 51.75 percent for Colorado, 11.25 percent for New Mexico, 23 percent for Utah, and 14 percent for Wyoming. In 1974, total withdrawals in the Upper Basin were approximately 3.2-3.7 million acre-ft/yr.[3] In short, Upper Basin states are entitled to some 1.5-2.6 million acre-ft/yr that is currently going to the Lower Basin.[4] This is more than twice the 0.6-1.0 million acre-ft/yr requirements estimated for the levels of energy development in our scenarios for the Upper Colorado River Basin states in the year 2000 (see Chapter 12).

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[1] Colorado River Compact of 1922, 42 Stat. 171, 45 Stat. 1064, declared effective by Presidential Proclamation, 46 Stat. 3000 (1928). The Boulder Canyon Project Act of 1928, 45 Stat. 1057, 43 U.S.C.A. §§ 617-617t (1964), authorized the division of the water among Lower Basin states as follows: California, 4.4 million acre-ft/yr; Arizona, 2.8 million acre-ft/yr; and Nevada, 0.3 million acre-ft/yr. Although the Act was not adopted by the states, the terms of the division were implemented by the U.S. Supreme Court in *Arizona v. California*, 373 U.S. 546 (1963), Decree 376 U.S. 340 (1964). The Colorado River Basin Project Act of 1968, 82 Stat. 885, 43 U.S.C.A. §§ 616aa-1 *et seq.* (Supp. 1976), provides that California is not to receive less than 4.4 million acre-ft/yr because of the Central Arizona Project.

[2] U.S., Department of the Interior, Water for Energy Management Team. *Report on Water for Energy in the Upper Colorado River Basin*. Denver, Colo.: Department of the Interior, 1974. This assumes that 0.75 million acre-ft/yr of the treaty obligation is to come from each basin. See the Treaty between the United States of America and Mexico Respecting Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, February 3, 1944, 59 Stat. 1219 (1945), Treaty Series No. 994.

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[1] The low estimate was made by the Lake Powell Research Project. See Weatherford, Gary D., and Gordon C. Jacoby. "Impact of Energy Development on the Law of the Colorado River." *Natural Resources Journal*, Vol. 15 (January 1975), pp. 171-213. The high estimate was made by Tipton and Kalmbach, Inc. *Water Supplies of the Colorado River*, in U.S., Congress, House of Representatives, Committee on Interior and Insular Affairs. *Lower Colorado River Basin Project*. Hearings before the Subcommittee on Irrigation and Reclamation, 89th Cong., 1st sess., 1965, p. 467. The most frequently used estimate is the 5.8 million acre-ft/yr of the DOI Water for Energy Management Team.

[2] Upper Colorado River Basin Compact of 1948, 63 Stat. 31 (1949).

[3] This is the estimated total for all uses. Approximately 60 percent of this was for irrigation, 20 percent went to Denver via an interbasin transfer, 14 percent was lost through evaporation, and the remainder was consumed for energy, recreation, minerals and mining, livestock ponds, and municipal and industrial uses in approximately equal amounts. See U.S., Department of the Interior, Water for Energy Management Team. *Report on Water for Energy in the Upper Colorado River*. Denver, Colo.: U.S. Department of the Interior, 1974.

[4] At present, surplus water from the Upper Basin is being used to fill reservoirs at Lake Powell and Lake Mead and by California. When the Central Arizona Project (CAP) is completed in 1985, the water will be used there. In fact, the CAP is likely to withdraw water from the reservoirs that are now being filled. Between the time the reservoirs are filled and the CAP is completed, the surplus above California use will flow into Mexico. When the CAP becomes a large user, California is supposed to decrease its withdrawals to the 4.4 million acre-ft/yr to which it is entitled.

The Yellowstone River is the principal stream in the Upper Missouri River Basin that will be affected by energy development in our scenarios. In 1950, Montana, North Dakota, and Wyoming became parties to the Yellowstone River Compact, which allocates the water available in the Yellowstone.[1] This compact recognized appropriations for beneficial use that already had been made and divided the water remaining in the tributaries of the Yellowstone as shown in Table 14-1.[2] The DOI Water for Energy Management Team estimates the collective average annual flow for these tributaries to be approximately 4 million acre-ft/yr.[3] An estimated 3.6 million acre-ft/yr of this flow is unappropriated at present,

TABLE 14-1: INTERSTATE COMPACT DIVISION
OF WATERS IN THE TRIBUTARIES
OF THE YELLOWSTONE RIVER

Tributary	Percentage to	
	Wyoming	Montana
Clarks Fork River	60	40
Big Horn River	80	20
Tongue River	40	60
Powder River	42	58

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[1] Yellowstone River Compact of 1950, 65 Stat. 663 (1951).

[2] "Beneficial use" is defined differently by different western states. A typical definition is: the use of that amount of water that is reasonable and appropriate under reasonably efficient practices to accomplish without waste the purpose for which the water appropriation is lawfully made. (Colorado Revised Statutes § 37-92-103(4) (1963).

[3] U.S., Department of the Interior, Water for Energy Management Team. *Report on Water for Energy in the Northern Great Plains Area with Emphasis on the Yellowstone River Basin*. Denver, Colo.: Department of the Interior, 1975.

which is roughly three times the estimated 1.0-1.8 million acre-ft/yr needed to support the levels of energy development in the Upper Missouri River Basin called for in our scenarios for 2000[1] (see Chapter 12).

If these estimates of unappropriated surface water in the Upper Colorado and Upper Missouri River Basins are even approximately accurate, water availability for energy resource development should not be a significant problem, especially in the Upper Missouri. However, the picture described above may be incomplete and somewhat misleading because: the in-stream flows are averages and much lower flows may occur in some years;[2] although, with the possible exception of New Mexico, none of the states in the Upper Colorado is actually using all the water it is entitled to, several states have at least tentatively distributed their total entitlement; if quantified, federal and Indian rights could reduce the amount of water that states have available to distribute; and present users of the surplus water in both river basins, but particularly in the Colorado may be reluctant to relinquish their use of this water. All four of these factors can possibly affect the availability of water for energy resource development.

Most states in the study area are concerned that they might lose water to which they are entitled but are not currently withdrawing for a beneficial use. Their own intrastate water appropriation systems generally provide that not putting appropriated water to a beneficial use is grounds for cancellation of a water right and that a water right can be established by use. These states fear that out-of-state user(s) might establish a right to waters that have been appropriated by the state but are not actually being put to a beneficial use at present. As a consequence, some states are trying to put the water to a beneficial use as soon as possible to guard against this happening.

Competition among water users is also likely to become more of a problem if large-scale energy resource development takes place. The current energy developments in the area have already contributed to increased water costs, and large-scale operations could help drive costs higher, even if water supplies ultimately prove sufficient for both energy and other developments. Thus, unless the federal government intercedes, water costs may become prohibitively high for irrigation and some other uses. However, agricultural uses of water in the West have a long history of being subsidized by the federal government, and agricultural users are not likely to give up without at least attempting to flex their political muscle.

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[1] Although other areas of the Upper Missouri will be affected by western energy development, enough water is available to meet energy and other uses to the year 2000 and conflicts over potential scarcity have not yet emerged.

[2] Flows can be maintained for some time by the release of impounded water; however, several successive dry years would present a problem.

As discussed below, energy resource development appears to be less of a water quality problem than some other uses, particularly agricultural irrigation. Thus, Lower Colorado River Basin states, such as California, and energy developers share a common interest in the competition among users; that is, Lower Basin states would be less affected if any increased consumption of water in the Upper Basin is for energy rather than agricultural development.

Unquantified federal and Indian water rights might also create some rather significant water availability problems. In large part this is because of the reservation or Winters doctrine which provides that each time the federal government sets aside land from the public domain for a federal purpose, including Indian reservations, it implies a reservation of water resources to meet the needs of that land. This doctrine was first applied in 1908 in Winters v. United States.[1] Since then, the doctrine has been extended by the courts to hold that federal rights are not subject to state appropriation laws and regulations and that federal water rights are not lost if they are not used.[2]

Under the reservation doctrine, Indian tribes potentially control large quantities of water in the West. Since most Indian lands were set aside in the nineteenth century, Indian water rights are sometimes referred to as "prior and paramount".[3] As shown in Figure 14-1, many of the surface sources of water for energy development flow through or border reservations. If Indians are ultimately found to hold prior and paramount rights,

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[1] Winters v. U.S., 207 U.S. 564 (1908).

[2] These two extensions of the reservation doctrine are the product of over 50 years of refinement of the Winters ruling. See Harris, Richard W.; William D. Jeffery; and Blair W. Stewart, Jr. Interstate Environmental Problems. Stanford, Calif.: Stanford Environmental Law Society, 1975, p. 51.

[3] In U.S. v. Ahtanum Irrigation District, 236 F. 2d 321, 327 (9th Cir. 1956), cert. denied, 352 U.S. 988 (1957), the 9th Circuit Court of Appeals held that Indians are entitled to the total flow of a stream when the total stream flow is required to meet their needs.

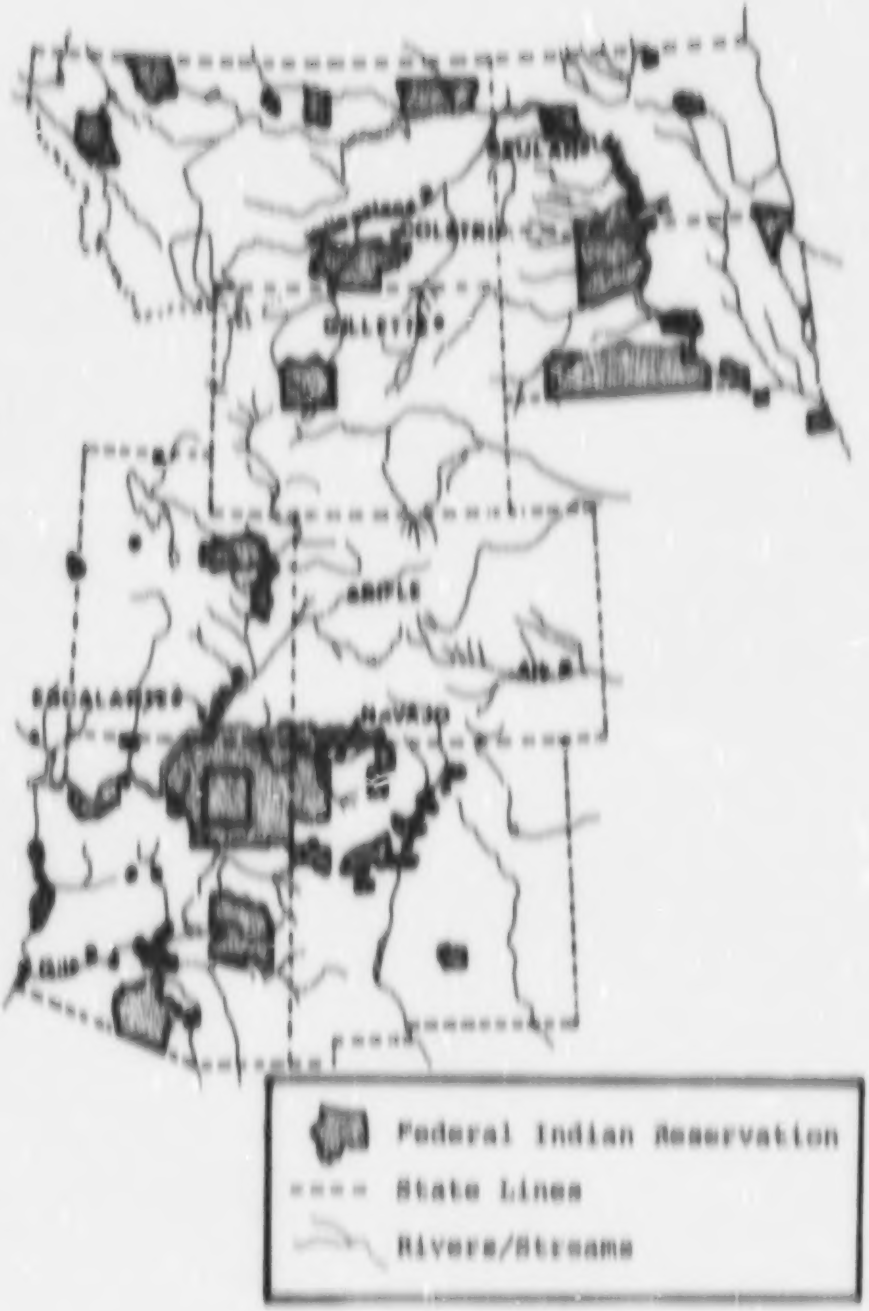
COLSTRIP
BEULAH
GILLETTE
RIFLE
ESCALANTE
NAVAJO
Federal Indian Reservation
State Lines
Rivers/Streams

FIGURE 14-1: WESTERN RIVERS IN RELATION TO INDIAN RESERVATIONS

existing allocations and appropriations among and within western states could be seriously affected.[1]

Since Federal rights are potentially quite large, not subject to state appropriation laws and regulations, and possibly reserved, their quantification could also seriously affect the states and present water users. However, unlike some Indian tribes, the federal government is not pressing for the quantification of its rights; in fact, federal agencies, particularly the Bureau of Reclamation, are working with the states and within the state water rights systems.[2]

In the past, a majority of states that would be affected have advocated that Indian and federal water rights be quantified as a means of lessening their uncertainty about their water future. However, several states now oppose quantification. A major reason for the change is that so long as these rights remain ambiguous, states can continue to distribute the water. Also, if and when their right to distribute the water is challenged, the states can claim that they have established a right by virtue of their past use.[3]

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[1] In Arizona v. California, 373 U.S. 546 (1963), Decree 376 U.S. 340 (1964), the U.S. Supreme Court said that Indian water rights were included in the interstate compacts. If this interpretation is applied generally, states would have to absorb any changes resulting from the quantification of Indian water rights. Since Indians already exercise some of their water rights, primarily for agricultural uses, any such increases may not be so large as to create a separate problem.

[2] About 4 years ago, a number of water quantification cases in Colorado that included the federal government as a party were consolidated. In his presentation at the Rocky Mountain Mineral Law Foundation's Uranium Exploration and Development Institute in Denver on November 19, 1976, Theordore E. Worcester stated that a draft report by the Master Referee in the consolidated cases was issued on November 5, 1976. According to Worcester, the report is unfavorable as concerns federal water rights, finding that (1) federal reserve rights are only those reasonably foreseeable at the time of the reservation, and (2) the federal government has only a reasonable time to quantify its rights. Of course, this draft report must still pass through the Colorado state courts and probably the U.S. Supreme Court.

[3] Pelcyger, Robert S. "Indian Water Rights, Some Emerging Frontiers," in Rocky Mountain Mineral Law Foundation. Rocky Mountain Mineral Law Institute: Proceedings of the Twenty-First Annual Institute, July 17-19, 1975. New York, N.Y.: Matthew Bender, 1975, pp. 753-794.

Together, these water availability problems and issues emphasize the potential importance of technologies to minimize water use in meeting the requirements of energy resource and other kinds of developments. As the summary of our water analysis results in Chapter 3 indicates, water requirements can vary greatly among technologies producing the same fuel and for the same technology at different sites. Deploying those technologies configured and/or sited to use as little water as possible can help to reduce the uncertainties of water availability.

B. Groundwater

Groundwater resources are even less well defined than are surface waters. Even where estimates of total quantities of groundwater are available, the recoverable portion of these resources is usually not known because of a lack of knowledge about location, depth, quality, and aquifer characteristics.[1] However, despite this lack of knowledge, groundwater may become a principal source of water for energy resource development in some parts of the West (see Chapter 9). Also, groundwater is the principal source of water for municipal water supplies in all our scenarios.

Although surface and groundwater systems are interrelated,[2] the potential problems of groundwater availability and use have not received as much attention as surface water problems. In general, groundwater law appears to be developing in a pattern parallel to the way surface water law developed. However, there are no interstate compacts dividing interstate groundwater resources among the states,[3] it is not clear that the reservation doctrine is also applicable to groundwater, and the effects of surface or groundwater withdrawals on groundwater or surface water availability are just now beginning to be dealt with by the courts.[4]

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[1] U.S. Department of the Interior, Bureau of Reclamation, Westwide Study Report on Critical Water Problems Facing the Eleven Western States. Washington, D.C.: Government Printing Office, 1975, p. 50.

[2] *Ibid.*, p. 42.

[3] The Madison Aquifer, for example, is found in three states: Montana, North Dakota, and Wyoming.

[4] *U.S. v. Cappaert*, 426 U.S. 128 (1976) at 143. The U.S. Supreme Court, in an unanimous decision, found that "...since the implied reservation of water doctrine is based on the necessity of water for the purpose of the federal reservation, we hold that the United States can protect its water from subsequent diversion, whether the diversion is of surface or groundwater."

The importance of groundwater resources can be expected to increase, particularly if some of the potentially significant surface water problems discussed above arise and if groundwater is tapped as a principal water source for energy development in some parts of our eight-state study area. In some parts of the study area, groundwater is already being mined.[1] This may occur with increased frequency when (and if) large-scale energy developments take place.

14.2.3 Water Quality

A. Introduction

Although the water quality impacts of energy development will be regulated by both the states and the federal government, the federal government has taken the lead in this area, especially with regard to surface waters. The federal objective has been to protect and restore water quality, primarily by either establishing or requiring the states to establish water quality and effluent standards. This section identifies and briefly describes the major federal water quality programs, describes the states' implementation role, and identifies and discusses some of the water quality problems and issues that might arise as a consequence of western energy resource development.

B. Federal Water Quality Programs

As developed since the original Federal Water Pollution Control Act was enacted in 1948,[2] federal efforts to reduce and control water pollution include both regulatory and assistance programs. Current programs include the regulation of: point source discharges, nonpoint sources, oil spill and hazardous substances, vessel sewage, and disposal of dredge and fill materials. Assistance programs presently provide grants for wastewater treatment works, salinity control projects, program development, technical assistance, and manpower development.[3]

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[1] This means it is being used faster than the underground reservoir is being recharged.

[2] Federal Water Pollution Control Act of 1948, Pub. L. No. 80-845, 62 Stat. 1155. The current act is the Federal Water Pollution Control Act Amendments of 1972, Pub. L. No. 92-500, 86 Stat. 816, codified at 33 U.S.C.A. §§ 1251, et seq. (Supp. 1976).

[3] Assistance programs are not described in this section. However, some of these programs are discussed in Section 14.7.

As articulated in the Federal Water Pollution Control Act Amendments of 1972 (FWPCA),[1] the federal government's water quality program has set goals of: water clean enough for boating and fishing by 1977; water clean enough for swimming by 1983;[2] and zero discharge of pollutants into navigable water by 1985.

1. Point Sources

The program to regulate point sources is known as the National Pollutant Discharge Elimination System. Under this program, no effluent can be discharged by a point source (such as municipal and industrial dischargers, including the energy facilities deployed in our seven scenarios) without a permit that sets the conditions under which the discharge may be made. These conditions include insuring that all requirements of the FWPCA are met. Permits are issued by Environmental Protection Agency (EPA) or the state (if the state program has been approved by EPA).[3] However, even when EPA has approved a state program, it still retains control since it can veto any individual permit proposal and withdraw its approval of a state's entire permit program.

In working toward the 1985 goal of zero discharge into navigable waters, FWPCA established two interim levels of effluents standards: by July 1, 1977, all point source dischargers except publicly owned treatment works are required to meet an effluent level defined by the "best practicable control technology currently available"; and by July 1, 1983, these dischargers must meet a level defined by the "best available technology economically achievable".[1] The reference point for the 1983 levels for all point sources is the 1985 goal of zero discharge.[2] Both the 1977 and 1983 technology-based standards are defined when EPA issues discharge permits and establishes effluent standards for each category of discharges.

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[1] Federal Water Pollution Control Act Amendments of 1972, § 101(2), 33 U.S.C.A. § 1251(a) (Supp. 1976).

[2] U.S., Environmental Protection Agency. Clean Water. Report to Congress--1974. Washington, D.C.: Environmental Protection Agency, 1974.

[3] To be approved by EPA a state's laws must authorize the state to: (1) issue permits that apply all FWPCA requirements; (2) monitor permitees to the extent required by the FWPCA; (3) notify the public when an application is made and provide an opportunity for a public hearing; (4) give EPA, downstream states that would be affected, and the Corps of Engineers an opportunity to object; and (5) impose requirements on publicly owned treatment facilities. See Dolgin, Ernie L., and Thomas G.P. Guilbert, eds. Federal Environmental Law. St. Paul, Minn.: West, 1974, p. 735. Four of the eight states in our study area have EPA approved programs: Colorado, Montana, North Dakota, and Wyoming. The regional EPA office issues permits in those states that do not have EPA-approved permit programs.

The FWPCA requires the Administrator of EPA to set effluent standards for new point sources to provide:

> ...the greatest degree of effluent reduction ...achievable through application of the best demonstrated control technology, processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants.[3]

Subsequent to these standards being established, they must be met by all new point sources in each category. Point sources that existed prior to the establishment of new source standards in their categories must meet the conditions contained in their discharge permit. New source standards have been established for the 27 major industrial categories listed in the FWPCA as well as a number of others. Those standards affecting western energy resource development include: coal mining, ore mining and dressing (uranium), steam electric power plants, and petroleum refining.

The FWPCA also requires the Administrator of EPA to set effluent standards for toxic pollutants.[4] These standards are to provide for "ample safety" and can prohibit the discharge of a toxic pollutant altogether. Several pesticides, benzidene, and polychlorinated biphenyls were subsequently designated as toxic pollutants and standards established regulating their discharge. In 1976 Congress enacted the Toxic Substances

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[1] By 1977, publicly owned treatment works are required to meet levels achievable using "secondary treatment", and by 1983, the "best practicable waste treatment technology over the life of the works."

[2] Dolgin, Erica L., and Thomas G.P. Guilbert, eds. *Federal Environmental Law*. St. Paul, Minn.: West, 1974, p. 695.

[3] Federal Water Pollution Control Act Amendments of 1972, § 306, 33 U.S.C.A. § 1316 (Supp. 1976).

[4] Toxic pollutants are defined to include any pollutant that is toxic to any organism and that might cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions, or physical deformations.

Control Act,[1] thereby placing greater emphasis on the control of such substances and greatly expanding EPA's responsibility for identifing and controlling them.

Effluent standards also apply to thermal discharges. However, if the point source discharger can show that the limitation on the thermal component of his discharge is "more stringent than necessary to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is made", EPA or the state issuing the discharge permit may make an exception for the thermal component.[2]

Prior to 1972, the major federal water quality program required the states to adopt water quality standards that met the approval of the Secretary of the Interior (the Administrator of EPA after EPA was created).[3] Under the FWPCA, existing water quality standards for interstate waters continue in effect and new standards require federal approval. These standards are enforced under the FWPCA requirement that all dischargers meet the technology-based effluent standards discussed above or more stringent limitations if such limitations are necessary to implement water quality standards established under the FWPCA.[4] Streams or segments of streams can be designated as being either "effluent limited" or "water quality limited";[5] discharges into a "water quality limited" stream are subject to more stringent limitations.

All these point source requirements affect energy resource development in the western U.S. The effluent standard limitations have the effect of requiring discharges to be treated or cooled. For example, water used for processing and flue gas desulfurization would have to be treated and thermal discharges cooled (unless the developer can show that the facility qualifies for the thermal discharge exception described earlier). However, the costs of supplying water may make it more economical for the developer to continue to treat and recycle the water as long as possible. Whether because of the economics or the FWPCA requirements, the decision to treat and recycle is often coupled with a decision to discharge effluents into evaporative ponds rather than to discharge treated effluents into navigable waters. As discussed in Chapter 12, solid wastes (including wastes from processing and flue gas desulfurization) will accumulate in these ponds and can create potentially significant surface and groundwater quality problems. The policy point here is that the FWPCA requirements aimed at protecting surface water quality may contribute to the decision to use water and effluent disposal alternatives that can lead to other potentially serious water quality problems.[1] Specifically, the pollutants can be accidently released into surface waters, leach into groundwaters, and constitute a long-term waste accumulation problem after the energy development has been shut down.

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[1] Toxic Substances Control Act of 1976, Pub. L. 94-469, 90 Stat. 2003 (to be codified at 15 U.S.C.A. §§ 2601 *et seq.*)(1976).

[2] Dolgin, Erica L., and Thomas G.P. Guilbert, eds. *Federal Environmental Law*. St. Paul, Minn.: West, 1974, p. 712. The authority to make this exception is explicitly stated in the statute (Section 307).

[3] Water Quality Act of 1965, Pub. L. No. 89-234, 79 Stat. 903 (1965).

[4] Federal Water Pollution Control Act Amendments of 1972, § 303, 33 U.S.C.A. § 1313 (Supp. 1976).

[5] U.S., Environmental Protection Agency. *Clean Water. Report to Congress--1974*. Washington, D.C.: Environmental Protection Agency, 1974, p. 8.

One aspect of accumulating wastes in evaporative ponds that may be particularly significant is the presence of trace materials. As indicated in Chapters 6-12, the quantities of trace materials that may accumulate in such ponds is not known, but even small concentrations of the more toxic materials could produce acute effects and thus must be viewed as potentially significant problems. In effect, discharging such waste materials into evaporative ponds creates a potential nonpoint source of pollutants similar to some nonpoint sources discussed in the following section.

2. Nonpoint Sources

The federal government's water quality program also deals with nonpoint sources such as those that result in "...runoff, seepage, and percolation of pollutants to surface and groundwaters through diffuse and undefined routes."[2] Irrigated and non-irrigated farming, mining, urban runoff, and rural sanitation are examples of nonpoint sources.

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[1] The material stated above about the role of economics in the decision to treat and recycle water and pond effluents should not be ignored. What we have found at this early stage in our analysis is not that the FWPCA is the sole cause but that it may be a contributing cause. It should also be noted that if effluents are ponded rather than discharged into a navigible stream, no environmental impact statement is required.

[2] U.S., Environmental Protection Agency. Clean Water, Report to Congress--1974. Washington, D.C.: Environmental Protection Agency, 1974, p. 14.

Section 208 of the FWPCA establishes procedures under which states or regional agencies are required to establish nonpoint source regulatory programs.[1] These procedures require the governor of each state to designate areas within their states that have "substantial water quality problems"[2] and "a single representative organization including elected officials from local governments or their designees" as the 208 areawide planning agency. The designated planning agency is required to operate "a continuing areawide waste treatment management planning process."[3] EPA must approve the plans prepared by the designated planning agency.[4]

Areawide plans must address nonpoint source pollution problems that are related to: agriculture and silviculture; mining, including "new, current, and abandoned surface and underground mine runoff";[5] construction; and "salt water intrusion into rivers, lakes, and estuaries resulting from reduction of fresh water flow from any cause, including irrigation, obstruction, groundwater extraction, and diversion."[6] Solid waste disposal problems that might affect surface or groundwater quality must also be addressed in these plans.

When the plan is submitted for EPA approval, the governor must designate "one or more waste treatment management agencies, which may be an existing or newly created local, regional, or state agency or political subdivision" to carry out the plan.[7] No permit may be issued that violates any of the plan's provisions.

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[1] See Section 14.7 for a discussion of the assistance aspects of the section 208 program.

[2] Federal Water Pollution Control Act Amendments of 1972, § 208, 33 U.S.C.A. § 1288 (Supp. 1976).

[3] FWPCA, § 208, 33 U.S.C.A. § 1288 (Supp. 1976).

[4] Dolgin, Erica L., and Thomas G.P. Guilbert, eds. Federal Environmental Law. St. Paul, Minn.: West, 1974, p. 767.

[5] FWPCA, § 208(b)(2)(G), 33 U.S.C.A. § 1288(b)(2)(G) (Supp. 1976).

[6] FWPCA, § 208(b)(2)(I), 33 U.S.C.A.

[7] FWPCA, § 208(c), 33 U.S.C.A. § 1288(c) (Supp. 1976).

As of early 1976, all eight states in our study area had designated areas having substantial water quality problems, and 22 areawide organizations had been designated.[1]

The report on the Colorado River Basin prepared for the National Commission on Water Quality by Utah State University's Utah Water Research Laboratory indicates that the salinity of the Colorado "...generally increases from the headwaters to the mouth".[2] This salinity increase is attributed to salt loading (i.e., adding salts to the river) and salt concentrating (i.e., consuming water from the river). Both nature and people contribute to salinity through both processes. The Utah Water Research Laboratory estimates that about two-thirds of the salt loading in the Colorado is due to natural sources and about one-third to "man-manipulated sources".[3] That laboratory also estimates that approximately 84 percent of the salt loading comes from nonpoint sources and 16 percent from point sources such as mineral springs (6 percent) and "artificial drainage of irrigation return flows" (10 percent).[4]

Although water quality concerns about the Colorado were expressed in federal legislation as early as 1956,[5] until the Water Quality Act of 1965[6] legislation generally did not establish standards but only provided for such things as studies of water quality, estimates of the effect of additional developments, and determination of the water's suitability for various uses. As noted above, the Water Quality Act required water quality standards to be established. This requirement led to a series of water pollution conferences to negotiate water quality for the

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[1] Bureau of National Affairs. *Environment Reporter*, p. 91:0121 (March 5, 1976).

[2] Utah State University, Utah Water Research Laboratory. *Colorado River Regional Assessment Study*, Part 1, *Executive Summary, Basin Profile and Report Digest*, for National Commission on Water Quality. Logan, Utah: Utah State University, Utah Water Research Laboratory, 1975, p. 2.

[3] *Ibid*.

[4] *Ibid*.

[5] See *Ibid*, pp. 97-98 for a description of this legislation.

[6] Water Quality Act of 1965, Pub. L. No. 89-234, 79 Stat. 903 (1965).

Colorado River system.[1] At the Seventh Enforcement Conference convened by EPA in early 1972, the seven Colorado River basin states agreed that salinity levels should be held at 1972 levels, that holding these levels should not prevent development in the Upper Basin, and that salinity control projects were preferable to salinity standards. During that same year, the FWPCA was enacted, authorizing EPA to impose numeric standards on the Colorado (and other rivers). In the following year, the U.S. entered into the agreement with Mexico discussed above, the effect of which was to limit the salinity of Colorado River water flowing into Mexico. And in 1974, the Colorado River Salinity Control Act was enacted to provide funding for construction of a large desalting complex in the Lower Basin, construction of a number of salinity control projects in the Upper Basin, and expedited planning for other salinity control projects.

In December 1974, EPA, under the authority of Section 303 of the FWPCA, published a regulation requiring that the average salinity in the Lower Colorado River be maintained at or below the 1972 level. To achieve this objective, Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming were required to adopt and submit to EPA for approval water quality standards including numeric criteria for salinity at appropriate points in the Colorado River system. These states were also required to: adopt a plan to achieve compliance with these standards; identify state and federal regulatory authorities and programs necessary to achieve compliance; and treat salinity as a basinwide problem of maintaining lower Colorado River salinity levels at or below 1972 averages as basin states continued to develop their compact-allocated waters. The EPA regulation stated that the goal of the plan should be to achieve compliance with the adopted standards by July 1, 1983.[2]

To meet these requirements, the seven Colorado River Basin states negotiated an agreement known as the "Proposed Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System, June 1975" and "Supplement" thereto dated August 26, 1975.[3] Together, these two documents constitute the water quality standards required by Section 303 of the FWPCA and EPA's December 1974 salinity control regulation. By November 1975, the appropriate state agencies had adopted these two documents and had submitted them to EPA.

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[1] Utah State University, Utah Water Research Laboratory, Colorado River Regional Assessment Study, Part 1, Executive Summary, Basin Profile and Report Digest, for National Commission on Water Quality. Logan, Utah: Utah State University, Utah Water Research Laboratory, 1975, p. 98.

[2] 41 Fed. Reg. 13, 656-57 (March 31, 1976).

[3] The agreement was negotiated within the Colorado River Basin Salinity Control Forum, which was formed to respond to EPA's salinity control regulations.

The numeric salinity standards are 723 milligrams per liter (mg/l) below Hoover Dam, 747 mg/l below Parker Dam, and 879 mg/l below Imperial Dam. The principal components of the plan are: (1) prompt construction and operation of the initial four desalting units provided for in the Colorado River Basin Salinity Control Act; (2) construction of 12 other salinity control units provided for in the Act (if the planning reports are favorable); (3) placing effluent limitations on industrial discharges; (4) reformulating authorized but unconstructed federal water projects to reduce the salt loading effect; (5) use of saline water for industrial purposes whenever practical; (6) programs by water users to cope with the river's high salinity; (7) studies of means to minimize salinity in municipal discharges; and (8) studies of future possible salinity control programs.[1]

Although at present, salinity problems in the Upper Missouri are not comparable to those encountered in the Colorado River Basin (see Chapter 12), energy resource developments will generally raise the same problems and issues in the basin. However, these problems and issues may be dealt with differently by the states in the two basins since salinity is already a serious problem in the Colorado but not in the Upper Missouri. Of course, energy resource development within the entire area will be regulated and controlled by the states and federal government, and the point and nonpoint sources regulatory programs discussed above will generally apply.

The impact analyses in Chapters 6-12 indicate that the water quality impacts of western energy resource development could include: runoff from mines, spoils piles, facilities, and urban areas; a contribution to the concentration of salts in surface waters due to the consumptive use of water; the accidental introduction of pollutants from evaporative ponds into surface waters; and the contamination of groundwaters, seeps, springs, and ponds.

As either point or nonpoint sources, energy resource developments apparently will not create as much of a salinity problem as would some other uses, particularly agricultural irrigation.[1] In general, the amount of water consumed (withdrawn and not returned) by such developments should not have much of a salt-concentrating effect on area surface streams.[2] These two tentative conclusions are important politically, particularly in the Colorado River Basin states because of the salinity problem that already exists there. For example, it is in California's interest to have any increase in water consumption in the Upper Basin be for energy or other non-agricultural uses because such uses will create less of a salinity problem.

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[1] See Fed. Reg. 13,656-57(March 31, 1976). Although salinity standards have been agreed to, permit criteria have not been established, and, as of February, 1977, the states and EPA have been unable to agree on how the standards are to be achieved.

However, finding that energy development will generally create less of a salinity problem does not solve all development-associated water quality problems and issues. Present salinity levels in the Colorado River Basin are so high that even the various kinds of runoff from development sites can become a problem, particularly during construction. Also, the accidental release of pollutants from holding ponds cannot be ruled out at this stage in our analysis, nor can the possible contamination of groundwaters by pollutants leaching from evaporation ponds and seeping from septic tanks in rural areas be ignored.

14.2.4 Conclusion

Some of the water availability and water quality problems that might arise as a consequence of energy resource development in the western U.S. have been introduced and described in this section. Although preliminary and incomplete, this introduction makes it clear that these problems and issues will be significant and that how they are dealt with will help to determine what energy developments actually take place in the West. The piecemeal approach to water problems used in the past will probably be inadequate for dealing with the complex water availability and water quality problems that can be anticipated for the future. Competition among users, the possible effects of quantifying Indian and federal water rights, the difficulty of dealing with nonpoint dischargers such as agriculture, the large economic cost of salinity control projects, the economic costs of minimizing water use, and the myriad of other problems and issues that we have just begun to identify and define seem likely to be beyond the capabilities of existing institutional arrangements. Thus, this complex of problems and issues will be a major component of our policy analyses during the remainder of this study.

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[1] See, for example, Holburt, M.B., and V.E. Valantine, "Present and Future Salinity of the Colorado River." Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol. 98 (March 1972), pp. 503-20.

[2] This does not eliminate the possibility of excessive salt concentrations occurring locally in some areas, and the basinwide effects must be examined in more detail than was possible during the first year. From the analysis of alternative futures, the Utah Water Research Laboratory concluded that taking water out of the river will have more of a salt-concentrating effect than will adding salts. This emphasizes the importance that finding ways to minimize water consumption is likely to acquire.

Many of the problems and issues discussed might well result in conflicts between the states and the federal government, between the states and Indian tribes, among the states, among a variety of water users such as farmers and energy developers, etc. If only some of these conflicts develop, they have the potential for overwhelming existing mechanisms for resolving conflicts. The primary mechanism at present is the court system, which is probably inadequate, in part because resolving problems this formidable in court is too time-consuming. However, a more fundamental reason that the courts are likely to prove inadequate is that these are really political problems, and the solution needed is a mutually acceptable accommodation, not a winner and a loser.

This brief examination underlines the critical importance of this category of substantive problems and issues. It also emphasizes the importance of the kind of information being produced by our impact analyses, particularly information on variations in water use among energy development technologies.

14.3 RECLAMATION

14.3.1 Introduction

As Chapter 1 indicates, most coal produced in the West is surface-mined. Thus, since coal production in the region is expected to increase substantially over the next 30 years, the amount of disturbed land will also greatly increase.[1] In part, this is a result of renewed national interest in coal, particularly western coal.

In this section, several problems and issues associated with surface mining and reclamation are discussed. Reclamation by revegetation receives more attention than do other alternatives for dealing with strip-mined lands. However, several alternatives to revegetation are identified and will be considered in later policy analyses. These may include the use of some surface-mined land for recreational purposes, such as conversion to recreational lakes, residential development, and building community facilities (for example, shopping centers) as the land is refilled.[1]

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[1] For instance, in the Stanford Research Institute's (SRI) Nominal Case level of development, approximately 200-400 thousand acres of land may be disturbed by the year 2000 in the eight-state study area, assuming all of the coal is surface-mined. See Chapter 12 for a discussion of the SRI model and assumptions for the Nominal Demand Case.

14.3.2 Western Ecosystems

The extent to which disturbed lands can be reclaimed depends on numerous site-specific factors, including the importance local residents place on the aesthetic value of their area. In Part II of this report, characteristics that make the West unique as a mining area in the U.S. (e.g., shortage of rainfall and relatively flat or rolling terrain) are discussed as they vary between major coal provinces. The following is not intended to duplicate those discussions but to identify how physical, geological, ecological, and technological characteristics affect the reclamation problems that must be dealt with by policymakers. In short, the contour of the land effectively defines the type of surface mining that occurs in the eight states (i.e., area mining), the lack of water in most of the eight states makes relatively long-term management a reclamation requirement, and the physical composition of soils is fundamentally important in terms of how overburden is handled and mixed and how contours are graded.

The context within which reclamation goals, policies, and practices are formulated is defined to a large degree by the technology of surface mining.[2] Area strip mining, as opposed to contour mining, is generally limited to lands with slopes of 14 degrees or less and with coal seams that are nearly horizontal. Except in a few areas in Colorado, western coal fields meet these criteria.

The first step in strip mining is to cut a trench or box to expose the resource. Each succeeding cut is made in a long, narrow strip parallel to the previous one and the overburden from the cut (the material that must be removed to expose the coal seam) is used to fill the previous trench. This is called backfilling.[1]

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[1] Although the potential for developing areas for recreation or residential development exists in the West, the isolated location of most mines limits the possibilities. As a result, most land will probably continue to be reclaimed for grazing, wildlife, and cropland.

[2] For additional discussions of coal resource development in the West and the technologies of surface mining, see White, I.L., et al. *Energy Resource Development Systems for a Technology Assessment of Western Energy Resource Development*. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

Because some strata in the overburden are inimical to plant growth, they may have to be buried so they do not contact plant roots or subsurface aquifers. Other subsurface layers can be placed on the surface to enhance growth. Depending on the complexity and composition of the overburden, segregating layers and respreading topsoil can be a simple or complex process that may or may not be specified by state reclamation laws.

After the trench has been backfilled, two stages of the reclamation process remain. First, the spoil banks (overburden) are graded. Under most state laws, the land must be shaped to conform with the contour of the surrounding area and thus reduce peaks, ridges, and erosion. Water impoundments are sometimes created and accessways provided to reclaimed areas. Second, some kind of vegetation is planted on the spoil material.[2] Although each mine and area has its special characteristics, most mines follow a process very similar to the one described here.

As noted earlier, most states require regrading to simulate the original contour of the land. Generally, this results in shaping the spoils to form a gently rolling surface. Regrading not only improves the aesthetic value of the reclaimed area but also increases the chances of successfully revegetating large surface areas.

In general, maximum plant stability cannot be achieved on slopes greater than 1:3 (a rise of 1 foot for each 3 horizontal feet).[3] Also, if the reclaimed land is intended for agricultural use, even gentler slopes may be required. Likewise, spoils that erode easily, such as those found in western North Dakota, may need to be graded nearly flat to control topsoil losses.

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[1] As noted below, several states now require operators to separate topsoil from the subsoil, stockpile the two separately so that they will not be inverted, and replace soil on the graded overburden.

[2] U.S., Congress, Senate, Committee On Interior and Insular Affairs. Coal Surface Mining and Reclamation: An Environmental and Economic Assessment of Alternatives, by Council on Environmental Quality, Committee Print. Washington, D.C.: Government Printing Office, 1973, pp. 12-14.

[3] U.S., Environmental Protection Agency. Guidelines for Erosion and Sediment Control Planning and Implementation, Environmental Protection Technology Series No. EPA R2-72-015. Washington, D.C.: Government Printing Office, 1972.

Even though regrading may optimize plant growth, it may interfere with wildlife. Early experiments in revegetating spoil banks that have not been regraded have often resulted in selective use of the spoils by various wildlife species.[1] Wildlife has actually diversified at some sites. When brush and range grasses selected for their value to wildlife are planted, dense thickets tend to grow in the valleys between the spoil ridges because of the high moisture level in the silt that collects there. Thus even if the sides of the ungraded spoil piles remain bare, the valleys between ridges may be impassable on foot. This combination of food and cover, inaccessibility by hunters, and the ability of the spoils to provide shelter from winter storms may make them a superior wildlife habitat.[2]

In the western U.S., the natural constraints of climate, soil, overburden, and vegetation ecology pose substantial problems for the second stage of reclamation revegetation.[3] In the process of removing topsoil, most existing plant cover is destroyed and left to decay in the middle of the spoils. Because of the conditions that exist in arid ecosystems, natural revegetation cannot be relied on to return the disturbed lands to productive uses in a time frame acceptable to some parties-at-interest.

Although a number of means are presently available to attempt to cope with revegetation constraints in semiarid regions, such as Colorado and the Northern Great Plains states, successful reclamation in the more arid areas is an unresolved issue.[4] In fact, many of the techniques being applied in semiarid locations are largely experimental because they have not been applied at the scale or rate at which they must be used if coal development in the West reaches projected levels. Further, methods have not yet been developed to a point where successful revegetation can always be assured. The present state of the art permits mine operators to improve the suitability of spoil material (e.g., by the placement of fertilizers, soil conditioners, and the use of mulches) as a medium for inducing plant growth, but success also depends on available moisture.

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[1] Gwynn, T.A. Rehabilitation of Lignite Areas of North Dakota Following Surface Mining, for the Knife River Coal Company. Bismarck, N.D.: Knife River Coal Company, 1965.

[2] This should not be interpreted to be an argument against reclamation.

[3] These constraints are further discussed in Section 12.5.

[4] Seeding is usually accomplished by seed drills or broadcast seeding techniques. An alternative that might reduce the susceptibility of revegetation attempts to drought during the first growing season would be to transplant native seedlings rather than use seeds per se (Personal Communication, Thadis W. Box, Dean College of Natural Resources, Utah State University.)

Available moisture is the most limiting and least controllable constraint on successful revegetation. Both the mean annual precipitation and the seasonal and temporal distribution of precipitation are important; generally, an annual minimum of 6-10 inches of precipitation is required for successful revegetation.[1] Annual precipitation levels on strippable land in northeastern New Mexico, southwestern Wyoming, and south-central Utah often fall below 10 inches. However, based on the results of several years of investigation of revegetating mining spoils, the U.S. Forest Service has found that when "mined and graded with care, and planted properly to suitable species, areas receiving as little as 6 inches average annual precipitation have been revegetated".[2] The timing of the precipitation appears to be much more critical than mean annual precipitation.[3] If most of the moisture occurs during one part of the year, and practically none occurs during another part (or at the right time of day to enhance seedling growth), reclamation practices may be further constrained by the need for and cost of irrigation, by wind erosion, and by other factors.[4]

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[1] See for example: National Academy of Sciences. *Rehabilitation Potential of Western Coal Lands*, a report to the Energy Policy Project of the Ford Foundation. Cambridge, Mass.: Ballinger, 1974, p. 3.

[2] Letter dated November 3, 1976 from Grant Davis, Associate Program Manager for Research, Forest Service Surface Environment and Mining Program (SEAM), U.S. Department of Agriculture.

[3] This is stated in the NAS study referred to earlier and is noted in Grant Davis' letter. In his comments on the NAS report, Robert R. Curry, Associate Professor of Environmental Geology from the University of Montana, stated: "Both soil formation and plant growth relies upon *soil moisture*, not rainfall, and in the arid west rainfall bears relatively little relationship to soil moisture. In addition to summer rainfall, concomitant summer evaporation which reduces soil moisture must be considered". Reviewer Comments in National Academy of Sciences. *Rehabilitation Potential of Western Coal Lands*, a report to the Energy Policy Project of the Ford Foundation. Cambridge, Mass.: Ballinger, 1974, p. 168.

[4] The Forest Service has been working with supplementary irrigation and finds that such equipment should be available for use as insurance against long dry periods regardless of average annual precipitation in the West. Letter dated November 3, 1976 from Grant Davis, Associate Program Manager for Research, Forest Service (SEAM), U.S. Department of Agriculture.

Although the use of supplemental water enables seedlings to grow more rapidly on most mine spoils, the reclamation of surface mined lands in the past in the Northern Great Plains has usually not included irrigation. In fact, the only large-scale commitment to irrigation at western coal mines is the sprinkler system installed at the Navajo Mine in New Mexico.[1] In part, this is because phasing water supplements out on arid test sites raises problems that still have not been solved. Even in semiarid places, such as the coal mining areas of Decker, Montana and Carbon County, Wyoming, there may be difficulty in withdrawing irrigation and fertilizer supplements because of unfavorable spoil and soil properties.[2]

In addition to this uncertainty about being able to withdraw supplemental water, irrigation also requires a long-term commitment to land management on the part of the developer. However, the more significant issue is likely to be that water used for irrigation is taken away from other productive uses.

To summarize, present knowledge about revegetation indicates that if semiarid locations have productive and stable soil, suitable plant species, and adequate amounts of seasonally distributed precipitation retained as soil moisture, surface-mined sites can be successfully reclaimed. The sites with the highest potential appear to be those in the northern Great Plains area, especially west-central North Dakota, southeastern Montana, and western North Dakota.[1] However, because of the close relationship between moisture and growth, there may be many cases where reclamation efforts will fail or be only marginally successful, especially if poor spoil or topsoil characteristics are combined with more arid climate. Also, erratic precipitation patterns over the lifetime of a given mine can result in unavoidable seeding failure. Some of the drier sites are especially uncertain with regard to revegetation, and in view of the many adverse influences against them, desert sites hold little promise for reclamation unless they are well managed, irrigated, and strictly controlled.

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[1] U.S. Environmental Protection Agency, Office of Energy Activities, Region VIII. *Surface Coal Mining in the Northern Great Plains of the Western United States: An Introduction and Inventory Utilizing Aerial Photography Collected in 1974 and 1975*. Denver, Colo.: Environmental Protection Agency, 1976, pp. 16-17. Annual precipitation rates at the Navajo Mine of approximately 6 inches have called for the use of supplemental water for at least 1.5 years. This underscores the point made earlier regarding the significance of soil moisture compared to mean annual precipitation.

[2] See Farmer, E.E., *et al*. *Revegetation Research on the Decker Coal Mine in Southeastern Montana*. Research Paper INT-162. Ogden, Utah: U.S., Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, 1974, p. 10. Similarly, after studying all growing factors and the climate of the Hanna Basin in Wyoming, it was the consensus of the Bureau of Land Management, Bureau of Reclamation, and the Geological Survey that supplemental irrigation should not be used in the revegetation plan "unless all other tested and proven dryland methods for establishing native vegetation, common and adapted to this area, fails". This recommendation was based principally on an assessment of the "shock" to so-called "established stands" of vegetative cover when irrigation and fertilizer were removed after a period of intensive use (e.g., 3 years). U.S., Department of the Interior, Bureau of Land Management. *Resource and Potential Reclamation Evaluation: Hanna Basin Study Site*. EMRIA Report No. 2. Rawlins, Wyo.: Bureau of Land Management, 1975, p. 172.

Several policy implications can be derived from these conclusions. First, operators may not be able to adhere strictly to inflexible legal requirements that require them to establish revegetation within a specified period of time. On the other hand, state reclamation programs that require a specific number of seeding attempts regardless of the success of the vegetative growth may be unrealistic. Second, plans for reclaiming surface-mined lands in some areas in the West may need to allow for consideration of alternatives to revegetation, such as recreation facilities or residential developments.[2] Third, in some arid areas, supplemental irrigation costs may be high enough to exclude some sites from consideration for energy development. At a minimum, it may be necessary to determine the water requirements for strip mining and reclamation in the early planning stages of an energy development and include these as a consideration in the permitting process.

These implications also suggest that even in areas with the highest potential for reclamation, states may have to acquire baseline information for enforcing reclamation laws over the life of a mine. This will require the integration of land-use goals and mine planning over longer time frames than are presently used, as well as comprehensive reclamation planning programs. To develop adequate programs for reclamation research, monitoring, and assessment, most of eight states will have to increase their reclamation funding, or the federal government will have to provide assistance.

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[1] Packer, Paul E. *Rehabilitation Potentials and Limitations of Surface-Mined Land in the Northern Great Plains*. General Technical Report INT-14. Ogden, Utah: U.S., Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, 1974.

[2] For a discussion of potential recreational or residential uses for surface-mined land, see Carter, Ralph P., *et al.* *Surface Mined Land in the Midwest: A Regional Perspective for Reclamation Planning*, for the U.S. Department of the Interior. Argonne, Ill.: Argonne National Laboratory, 1974, pp. I-60 to I-63. These alternatives will be given further consideration when this analysis is extended.

14.3.3 Regulation and Control of Reclamation by State Governments

While technologies, economics, and ecological conditions influence reclamation within the study areas (and to a great degree help define the scope of each state's response at each site), successful reclamation also depends on effective laws and administrative programs. The locus of regulation and control resides primarily with state governments. Both the federal and local governments are involved, but neither federal nor local regulations are explicitly written for surface mining and reclamation.

Before 1950, most surface mines in the West operated according to the unwritten principle that the disturbed land would be treated as a sacrifice area; that is, it would not be reclaimed.[1] As shown in Table 14-3, reclamation requirements in western states have been enacted relatively recently. The first mined-land reclamation act in the West was passed in 1967 by Montana (compared to the early-1900's laws in the eastern U.S.). Colorado, Montana, and Wyoming followed in 1969 (all three have since passed new laws), North Dakota in 1970, South Dakota in 1971, New Mexico in 1972, and Utah in 1975. Arizona has not enacted strip-mine legislation, but the state does require standard reclamation practices as a condition of mineral leases on state lands.

General regulatory powers and techniques are similar, although by no means uniform across the eight states.[2] Regulatory

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[1] Atwood, Genevieve. "The Strip-Mining of Western Coal." Scientific American, Vol. 233 (December, 1975), p. 27.

[2] For a more detailed description and analysis of state surface mining and reclamation laws and regulations, see U.S., Congress, Senate, Committee on Interior and Insular Affairs. *Coal Surface Mining and Reclamation: An Environmental and Economic Assessment of Alternatives*, by Council on Environmental Quality, Committee Print. Washington, D.C.: Government Printing Office, 1973, pp. 35-46; National Academy of Sciences. *Rehabilitation Potential of Western Coal Lands*, a report to the Energy Policy Project of the Ford Foundation. Cambridge, Mass.: Ballinger, 1974, pp. 95-99, 140-148; and Imhoff, Edgar A., Thomas O. Friz, and James R. LaFevers. *A Guide to State Programs for the Reclamation of Surface Mined Areas*, Geological Survey Circular 731. Washington, D.C.: Government Printing Office, 1976, pp. 7-29. The summary presented in this section relies on information from these three sources.

TABLE 14-2: SUMMARY OF SURFACE MINING AND RECLAMATION LAWS, REGULATIONS AND AGENCIES IN EIGHT WESTERN STATES

State	Title Legislative Act	Rules and Regulations have been Promulgated	Technical Guidelines have been Promulgated	Administering Agency
Arizona[a]				
Colorado	Colorado Open Mining Land Reclamation Act of 1973			Department of Natural Resources
Montana	Montana Strip and Underground Mine Reclamation Act (1975)	X	X (partial)	Department of State Lands
New Mexico	New Mexico Surface Mining Act (1972)	X		Bureau of Mines Coal and Mineral Resources
North Dakota	North Dakota Century code; Reclamation of Strip-Mined Land (1975)	X		Public Service Commission
South Dakota	Surface Mining Land Reclamation Act, as amended (1973)	X		Department of Agriculture
Utah	Mined Reclamation Act of 1975	X		Department of Natural Resources
Wyoming	Wyoming Environmental Quality Act of 1973	X		Department of Environmental Quality

X = denotes the existence of a program element

Source: Adapted from Imhoff, Edgar A., Thomas O. Friz, and James R. LaFevers. A Guide to State Programs for the Reclamation of Surface Mined Areas. Geological Survey Circular 731. Washington, D.C.: Government Printing Office, 1976, pp.22-23.

[a] The state applies standard reclamation requirements to state lands as a condition of mineral leases. Arizona also contains federal lands where reclamation requirements are a condition of mineral leases. Some local units of government use land-use controls and activity permits to encourage reclamation.

responsibility in each of the eight states is vested in a state agency. Permits costing from $50 to $200 per acre must be obtained from the respective agencies to surface mine in their states. In addition, miners must post a bond, the amount of which is based on predicted reclamation costs. Most bond amounts are between $100 and $600 per acre, with a $1,000-2,000 minimum. This bond can be reclaimed on satisfactory reclamation of the surface-mined land. (Several states permit a gradual releasing of the bond, as various stages of reclamation are achieved.) If mine operators default, the state agencies are responsible for completing the reclamation process, using the money from the forfeited bond. Several states permit the money to go into a general reclamation fund that can be used for reclamation anywhere in the state.

State laws also define the time during which reclamation must occur. The "standard" requirement allows reclamation activities to be delayed until after mining is completed (Colorado, North Dakota, Wyoming, and Montana permit this).[1] This contrasts with the requirement for concurrent reclamation in several eastern states.

State law generally defines the temporal limits of reclamation activity. For example, in Colorado, reclamation must be completed "with all diligence" and within 3 years of the time the operator says his reclamation work started. Where this amount of time lag is allowed (and 2-3 years is not uncommon), states must rely on setting performance bonds at amounts that will pay the actual cost of reclamation if operators fail to complete reclamation work.

All states require revegetation in the form of replanting and reseeding to restore the land to its original range, forest, or agricultural cropland conditions. While requirements vary considerably, most of the states see revegetation as an objective and specify the number of seeding attempts, timing, and/or seeding rates per acre to achieve that goal. However, several states require only a specified number of attempts at seeding (e.g., two are required in Montana and Wyoming) and have no criteria for defining successful revegetation. Under these laws, a total failure can be legally acceptable.

As mentioned above, revegetation is closely related to efforts to determine what constitutes the productive use of reclaimed lands. Given characteristics of climate, topography, wildlife, and water flow, various objectives can be set for the reclamation process. Obviously, determination of goals depends mostly on ownership of the land; that is, if the land to be surface-mined is privately owned, the goals may be different than if it is government-owned. When coal lands are privately owned and have been used for ranching or farming, the typical obligation is to restore the land to its previous productive use and value. In this case, regulations usually stipulate that range lands must be traverseable by livestock and farm lands by agricultural equipment. This entails regrading and shaping of highwalls and spoil banks to specified contours, such as "rolling topography" or "undulating skyline".

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[1] Many eastern states require reclamation concurrently with the on-going mining process. This can greatly facilitate enforcement since mining can be stopped if reclamation does not meet requirements.

Regardless of the specific language used, most state programs are designed to return surface-mined land to productive use.[1] However, meeting the productive use criteria can lead to special problems, particularly if operators are required to restore land to its original contours. Such a standard may preclude considerations like impounding water to help rebalance the ecology of the restored site, or it may block the development of recreation or residential lakes in particularly flat lands. Likewise, stipulations for "restoration of native vegetation" and "replacement of topsoil" can prove to be both inefficient and costly where an alternative use of the land has been defined (i.e., if the mined land is eventually to be submerged and a lake created).

In addition to these common provisions, some states make more specific reclamation requirements. For instance, Montana and Wyoming consider compensation for loss of water due to strip mining. Montana, North Dakota, and Wyoming will not grant permits for mining land determined to have unique value (historical, scenic, archeological, etc.) or which cannot be reclaimed according to statutory and planning criteria. The authority to deny mining permits in unique or otherwise irreplaceable areas has begun to be exercised more frequently in the last 5 years in the western states, and most of these states will probably become even more careful about issuing mining permits for such lands in the future.

Other specific regulations include Wyoming's requirement for a state agency to collect baseline data and monitor reclamation efforts. New Mexico, North Dakota, and South Dakota have aesthetic as well as technical criteria for rehabilitating disturbed lands.[1] Montana and Wyoming require frequent on-site inspection of both mining and reclamation. Finally, Montana calls its permit a "reclamation contract", which gives the state the additional enforcement option of suing the operator for breach of contract if reclamation is not adequate, or it allows action to be taken by the public against the state if the state is remiss in its enforcement responsibility.

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[1] For example, in Wyoming a mining permit may be issued only after a reclamation plan has been submitted which provides for rehabilitation of mined land "to a condition equal to or greater than the highest previous use". The land, after reclamation, must be suitable for the previous use which was of the greatest economic or social value to the community or area, or must have a use which is of more economic or social value than all other previous uses. Wyoming Statutes § 35-502.32 (Cumulative Supplement 1975). Wyoming Land Quality Rules and Regulations, Ch. 2, Sec. 1(b)(1), Department of Environmental Quality, Wyoming (1975).

Although the states in the study area have developed measures for regulating reclamation activities, it is difficult to assess the long-range consequences of their efforts, particularly since most of the laws were passed or substantially amended only recently. None of the eight states has statutory authority addressing all the requirements for adequate reclamation, and discrepancies often exist between legal requirements and regulations made to implement the law. Hence, to overcome existing conditions of limited knowledge, lack of surface-mining experience (in some cases), and uncertainty, policymakers may pass an intentionally general law which may result in weak regulations. This situation is magnified when standards and criteria guidelines are to be developed from the regulations. In fact, the eight states do not have standards and criteria for most reclamation activities. In a few cases, this lack of specificity avoids unreasonable inflexibility, but in other cases, it could result in detrimental environmental practices. Feasible standards, where they do not now exist, will probably be established as each state learns more fully what reclamation conditions can be attained at mining sites within their boundaries.

Regardless of the strength of a state's legal or regulatory pronouncements, effectiveness depends on the adequacy of enforcement procedures. Enforcement, in turn, depends on the manpower and funding levels of the designated administrative agency's reclamation program. In general, the western states have not been able to enforce their reclamation provisions, usually because they lack the necessary personnel and funds. Most existing manpower/funding levels seem to allow little more than administrative-clerical programs, rather than enforcement programs with skilled field personnel.

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[1] The aesthetics of shaping disturbed lands from coal surface mining has been the subject of research for no more than 5-6 years. However, as principles are developed, such analyses might be incorporated into the standards of other states. See Proshansky, J.H., W.H. Ittelson, and L.G. Rivlin, eds. Environmental Psychology: Man and His Physical Setting. New York: Holt, Rinehart and Winston, 1973; Litton, R.B., Jr. "Aesthetic Dimensions of the Landscape," pp. 262-291 in Krutilla, J.V., ed. Natural Environment: Studies in Theoretical and Applied Analysis. Baltimore, Md.: Johns Hopkins University Press, 1972; Craik, K.H. "Appraising the Objectivity of Landscape Dimensions," pp. 292-346 in Krutilla, J.V., ed. Natural Environment: Studies in Theoretical and Applied Analysis. Baltimore, Md.: John Hopkins University Press, 1972.

Also, performance bond requirements are not based on actual reclamation costs, which may extend over a longer period of time than that stipulated in most mining plans. Similarly, states have no provisions for training the needed research and inspection personnel to meet the specific requirements of reclamation and mining control.

While differences in legal requirements are to be expected, the range of variation noted above reflects the need for states to strengthen their individual programs, especially in terms of monitoring and enforcement, standards, and policy objectives. To do so requires not only adequate laws effectively administered but also coordinated efforts by local, county, state, and federal governments. Local and county governments can assist in this process by establishing adequate planning, zoning, and other land use programs that indicate to the state the wishes and interests of local residents, thereby integrating the role of local public planning into the development of reclamation programs.

14.3.4. State Control Over Reclamation on Federal Lands

To date, no federal legislation has been adopted for the express purpose of reclaiming lands disturbed by surface mining. However, several federal statutes and regulations do control the environmental impacts of surface mining on public lands or lands owned by the federal government.[1] Since substantial quantities of coal in the western states underlie federal lands, the extent of states' rights and authority over these lands has become an important jurisdictional issue.

Since 1940, 45 federal strip-mining bills have been introduced into the Congress. Of these, only two were passed, and both were subsequently killed by presidential veto.[2] President

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[1] Protection of land and water on federal lands are required by 25 C.F.R. 177 (1976); 30 C.F.R. 211 and 231 (1976); 43 C.F.R. 23 (1976).

[2] Magida, Arthur J. "Environment Report/New Move to Revive Strip Mining Bill Advances." National Journal Reports, Vol. 7 (December 6, 1975), p. 1679. Senate Bill 425 was designed to establish standards for reclamation of surface-mined lands, create a reclamation fund for abandoned lands, protect the rights of surface owners, and prohibit certain forms of strip mining. The veto was opposed by both the Department of the Interior and the Environmental Protection Agency. President Carter has announced that he plans to promote passage of a similar bill.

Ford said that he vetoed the 1976 bill because it would have severely hindered coal production, raised the price of coal, and been inflationary.

Because of this legal vacuum at the national level, states have, for the most part, enforced their own reclamation laws on federal lands, or reclamation requirements have been enforced under the terms of federal coal leases. Consequently, while mine operators might be required to obtain mining permits from both the state agency and the federal government, they were subject only to state reclamation laws, regulations, standards, and enforcement. Indeed, all the reclamation statutes passed by the western states either expressly or implicitly stipulate that the law applies to all mining activities within their boundaries, regardless of land ownership (federal, state, or private).[1] Although the Mineral Leasing Act of 1920 permits the Department of the Interior (DOI) to make regulations to fulfill the purposes of the Act,[2] reclamation regulations were not proposed until 1975.[3]

These proposed new regulations, governing both mine operations and post-mining reclamation, raised concern in the western states over the status of their regulatory role on federal coal lands. The language of the regulations, and subsequent discussions between state officials and DOI, revealed a federal view that federal reclamation provisions should prevail over state law on federal lands. Further, DOI held that the authority for designating federal lands suitable or unsuitable for mining was a federal responsibility. Though some progress has been made toward resolving the issue of which reclamation requirements will prevail, the question of development authority on federal lands is still open.

The first question regarding federal reclamation regulations was whether state standards would be adopted on federal lands if they were more stringent than federal regulations. The Federation of Rocky Mountain States summarized its members' position as follows:

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[1] Barry, Daniel J. *Legal Study: Extent of State Control Over Reclamation on Federal Land*. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, p. 1.

[2] National Mineral Lands Leasing Act of 1920, as amended, 41 Stat. 437, 30 U.S.C.A. §§ 181 *et seq*. (1971). For a discussion of federal pre-emption and the Mineral Leasing Act, see Shapiro, Michael F. "Energy Development on the Public Domain: Federal/State Cooperation and Conflict Regarding Environmental Land Use Control." *Natural Resources Lawyer*. Vol. 9 (No. 3, 1976), pp. 397-439.

[3] U.S., Department of the Interior, Geological Survey. "Coal Mining Operating Regulations." 40 Fed. Reg. 4428-38 (January 30, 1975) (to be codified in 30 C.F.R. 211 and 216).

> The federal government has the right and responsibility to promulgate rules and regulations with respect to surface mining reclamation operations on federal lands. These rules and regulations should be minimum standards, which are defined on performance based criteria and are as objective, clear, and concise as possible. Where state standards exceed federal guidelines the state's laws and regulations should be followed. Detailed regulations, or process designations of mining techniques, should not be a part of the federal rules and regulations because highly defined procedures impede the development of new and more sophisticated technologies. Also, the techniques required to accommodate the variable environmental, economic, and social conditions among the individual states demand flexibility in national guidelines.[1]

The Western Governors' Regional Policy Office also commented on the draft regulations:

> We recommend that in every instance where state reclamation standards are as stringent, or more stringent than, federal standards, the Secretary enter into a memorandum of agreement or understanding between that state and the appropriate federal agencies. Such agreement will specify the state shall have responsibilities for administration and enforcement of the applicable reclamation laws, unless that state shall specifically request other administration and enforcement procedures.[2]

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[1] Federation of Rocky Mountain States. Proposed Federal Surface Mining Reclamation Requirements: A Report on the Workshop Held July 30, 1975, Denver, Colorado, Regional Background Paper. Denver, Colo.: Federation of Rocky Mountain States, 1976, p. 4.

[2] Letter from William L. Guy, Western Governors' Regional Energy Policy Office, Staff Director to Secretary of Interior Thomas Kleppe, December 22, 1975, p. 2, as cited in Barry, Hamlet J. Legal Study: Extent of State Control Over Reclamation on Federal Land. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, pp. 5-6.

The revised regulations[1] made significant changes in this matter of state standards. According to the final draft, DOI was to begin an immediate review of state reclamation statues and regulations to determine those that afforded the general protection of environmental quality and values which would otherwise exist under application of federal rules. Where such provisions were at least as stringent, the states would be permitted as much control as is constitutionally possible, and specific agreements by memorandum would be entered into for purposes of joint enforcement and administration of reclamation programs.[2]

The regulations issued by DOI left the question of federal pre-emption largely unresolved. DOI subsequently found that Wyoming's reclamation standards and requirements would apply to four mining plans on federal coal leases in the western Powder River Basin and to the Rosebud preference-right lease in Sweetwater County. Despite these expressions of seeming "good faith" on the part of DOI, Wyoming charged that the federal government's recently issued regulations were unconstitutional in that they violated the state's police power authority. A suit was filed in U.S. District Court in Wyoming in June 1976,[3] in which the state argued that Secretary of the Interior Kleppe must recognize Wyoming's jurisdiction regarding mined land reclamation control and is required to exclude any lease provisions which might conflict with state law. Six months later, Kleppe consented to an agreement with the state of Wyoming allowing state standards for reclamation of coal mining on federal lands to take precedence over any conflicting federal standards.[4] Further, Kleppe said that DOI was ready to negotiate settlements with any other states having reclamation laws as stringent or more stringent than Wyoming's. Under provisions of the agreement, DOI agreed that a federal coal lessee must comply with "state laws and regulations regarding reclamation, regardless of what action Interior has taken in approving the lessee's mining plan".[5] Federal coal mining permits thus will be processed first by the state of Wyoming and, after gaining state support, will be submitted to the Secretary of the Interior.

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[1] U.S., Department of the Interior, Bureau of Land Management and Geological Survey, "Coal Mining Operating Regulations," 41 Fed. Reg. 20251-20273 (May 17, 1976) (to be codified at 30 C.F.R. §211.75(a)(b)).

[2] *Ibid.*, p. 20273.

[3] *Herschler v. Kleppe*, Docket No. C-76-108 (D. Wyo., filed June 9, 1976).

[4] "Wyoming Coal-Law Dispute Ends." *Denver Post* (December 4, 1976), p. 37L.

[5] *Ibid.*

Another issue is the question of who decides whether energy development should or should not occur on specific federal lands. New federal leasing regulations imply that pre-emptive authority belongs to federal government. The posture of the states is that the responsibility of designating land suitable or unsuitable for mining must rest with the states (once state standards and performance criteria have been determined acceptable under the regulations) "because the state has a better knowledge of the areas within its boundaries than the federal government"[1] and the state is also responsible for the protection, health, and welfare of its citizens. This problem may not be resolved without further litigation if and/or when specific federal-state disputes occur. As it presently stands, the situation underscores the interjurisdictional conflicts that energy development is causing in the West. It also indicates the need for continuing coordination of state and federal guidelines for reclamation where land ownership patterns are mixed.

14.3.4 Summary

Negative environmental impacts of surface mining on land uses, water flow and quality, wildlife habitats, and aesthetic values raise a number of policy problems and issues. Attempts to recondition strip-mined land are particularly problematic because of the natural constraints of climate, soil, and vegetation ecology of the western states. Of particular significance are the semiarid and arid conditions that exist in the states and the erratic seasonal distribution of precipitation that can impair efforts to revegetate surface-mine spoils. Thus, water management is a critical policy component in the reclamation process. Further, reclamation efforts take place in a legal, regulatory, and enforcement framework defined primarily by states but including federal and local input. Neither the federal government nor the states have completely adequate laws and regulations to control surface-mine reclamation.

This introductory analysis identified three categories of problems and issues which may constrain western reclamation programs: problems caused by the uniqueness of western ecosystems, problems related to state reclamation programs, and issues regarding state control over reclamation on federal lands. Each of these categories (and others as they are identified) will be expanded to include consideration of alternative policies and implementation strategies in the remaining years of this study.

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[1] Federation of Rocky Mountain States. *Proposed Federal Surface Mining Reclamation Requirements: A Report on the Workshop Held July 10, 1975, Denver, Colorado*, Regional Background Paper, Denver, Colo.: Federation of Rocky Mountain States, 1976, p. 33.

14.4 AIR

14.4.1 Introduction

This preliminary policy analysis identifies the existing legal and jurisdictional context of air quality controls and discusses three kinds of air quality problems and issues: non-significant deterioration requirements, inter-governmental relationships, and emission controls technologies. Several potentially significant problems and issues are not discussed, including the federal government's pre-emption of control over mobile sources (which contribute significantly to air quality problems in some areas) and problems faced by municipalities affected by stationary sources located in another jurisdiction (e.g., when an electric power generating plant is located in the county just outside city limits). These and other problems and issues not discussed in this section will be analyzed during the remainder of the project.

14.4.2 Legal and Jurisdictional Context

The Clean Air Act (CAA) of 1970 grants substantial authority and discretion to states for setting standards, developing plans for regulating standards, and enforcing those plans.[1] However, the extent of state authority depends on the kind of pollution being regulated; final control over air quality control programs remains with the Administrator of the Environmental Protection Agency (EPA).

The following section outlines the relative roles of the states and federal government in five categories of pollution control: ambient air quality, non-significant deterioration, new source performance standards, hazardous pollutants, and mobile sources. States have more control and responsibility over ambient air quality and non-significant deterioration than they do over the other three areas. However, except for mobile sources, states are required to submit State Implementation Plans (SIP's) to EPA for all five areas. The primary purpose of SIP's is to indicate how states will meet pollution standards and enforce applicable laws within the powers granted by the CAA. These powers include, for example, the authority to: abate pollution emissions on an emergency basis; prevent the construction of any facility that would prevent the attainment of standards; and monitor the performance of facilities. EPA retains supervisory authority to approve or disapprove states' plans, to take over state plans if necessary, and to allocate federal funds based on these plans.

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[1] Clean Air Act of 1970, Pub. L. No. 91-604, 84 Stat. 1676 (codified at 42 U.S.C.A. §§ 1857 *et seq.*) (Supp. 1976). Technically, the 1970 laws are amendments to the Clean Air Act. However, these amendments are so substantial that the 1970 enactment is generally referred to as the Clean Air Act.

In addition to supervising state plans, EPA can penalize violators by assessing fines of up to $25 thousand or 1 year in prison per day of violation. The EPA Administrator may also go directly to court to enforce standards if other enforcement procedures have failed. However, EPA can also be sued to compel enforcement of air quality standards.[1]

A. Ambient Air Quality

Ambient air quality standards are set by EPA to limit the atmospheric concentrations of six "criteria" pollutants regardless of their source: carbon monoxide, sulfur dioxide (SO_2), particulates, nitrogen dioxide, photochemical oxidants, and hydrocarbons.[2] Two levels of standards are set for each of these pollutants. "Primary standards" set maximum concentrations that would not endanger public health. "Secondary standards", which are more restrictive for SO_2 and particulate levels, are set to protect public welfare.

Although EPA sets national ambient air standards, states have the initial burden of developing plans specifying how the national standards would be achieved, maintained, and enforced. For example, a primary measure of state control is to prescribe specific emissions limitations for types of polluters. Additionally, states may develop stricter standards than those developed by EPA.

B. Non-Significant Deterioration

The non-significant deterioration (NSD) clause of the CAA is designed to limit the concentrations of pollutants that can be added to areas where the air is relatively clean (i.e., areas where the air quality is better than that allowed by ambient air standards). In 1974, EPA developed regulations to define NSD according to an area classification system.[1] Three classifications for clean air areas were created which provide for progressively larger incremental additions to existing concentrations of SO_2 and particulates to be considered insignificant.[2] (These two pollutants were the only ones covered by the system.) Class I increments allow the lowest level of incremental increases and are intended to protect the cleanest areas in the nation, such as national parks and wildlife sanctuaries. Class II areas allow larger increments but ones that are still well below national ambient air standards. Class III areas allow the largest incremental increases and are essentially special exception zones where deterioration to national primary standards is allowed.[3] As is true for ambient standards, states have the initial burden of developing plans to meet and maintain PSD allowable increments.

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[1] The CAA provides for strong citizen suit actions. Any citizen can either sue EPA to compel enforcement or go directly to court if EPA has not already brought suit.

[2] Concentrations of criteria pollutants are measured at ground level for specified time periods: 3-hour, 24-hour, and annual average.

The allowable increments of particulates and SO_2 to Class I and Class II areas apply to all new sources whether located within or outside the areas. This effectively establishes a buffer zone around Class I and II areas within which new facilities cannot be sited since pollutants from the facility must be diluted by atmospheric mixing to the allowable concentrations. The distance required for dilution determines the size of the buffer zone. This zone varies by facility type, size, and effectiveness of emission controls. Impact analyses for our site-specific scenarios show buffer zone requirements ranging from 5 to 75 miles.[4] The size of buffer zones may become a critical siting and emission control consideration, especially if more clean air areas become mandatory Class I or Class II.

C. New Source Performance Standards

New Source Performance Standards are designed to insure that ambient standards are met, and limit the amount of a given pollutant a stationary source may emit over a given time.

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[1] The development of this system was precipitated by law suits which challenged that ambient air standards by themselves were insufficient to meet the letter and spirit of the CAA. See *Sierra Club v. Ruckelshaus*, 344 F. Supp. 253 (D.D.C. 1972), *affirmed*, 4 ERC 1815 (D.C. Cir. 1972), *affirmed sub nom.*, *Fri v. Sierra Club*, 412 U.S. 541 (1973).

[2] Although three classes were established, all clean air areas were initially designated as Class II. States may redesignate Class II areas as either Class I or Class III only after a formal process requiring public hearings.

[3] Refer to the air sections of Chapters 6-11 for the actual increments allowed under PSD.

[4] See Section 3.2 for a summary of findings related to PSD.

"New" in this context applies to facilities built since August 17, 1971 and to significant modifications of old facilities. New source standards are for the same six criteria pollutants as ambient air standards but are applied differently to various categories of sources.[1]

EPA has complete responsibility for identifying categories of new sources, developing standards for each source, and initial responsibility for developing plans to abate new source population. States must develop plans for implementing and enforcing the plans and standards; however, they do have the option to set stricter standards.

D. Hazardous Air Pollutants

The "hazardous air pollutants" category allows even stricter standards than ambient air quality for pollutants that are considered to cause or contribute to increased mortality or serious illness.[2] Asbestos, beryllium, and mercury are currently considered hazardous, and separate emissions levels and/or uniformly applicable control equipment requirements have been established for these materials. The initial burden for controlling hazardous pollutants rests with EPA, although states implement and enforce these plans.

E. Mobile Sources

Mobile source pollutants, most notably automobile emissions, are a third area left primarily to EPA regulation. This category of pollution control is designed to reduce emissions of hydrocarbons and carbon monoxide by 90 percent from 1970 levels.

14.4.3 Non-Significant Deterioration

EPA's classification system has apparently spurred rather than quieted, the debate over protection of the nation's clean air. Many environmentalists claim that the classification system is still inadequate, and many energy producers claim that it restricts the development of new energy resources. In part, these disagreements have increased the probability of Congressional intervention. In 1976, both the House and Senate considered, but did not pass, bills to amend current NSD regulations. Both bills provided for a stronger federal role in the protection of certain kinds of lands by requiring some areas to be designated Class I at the outset, rather than initially designating all areas Class II as EPA did.

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[1] New source categories are portland cement, municipal incinerators, fossil-fuel generators, asphalt concrete plants, petroleum refineries, petroleum storage vessels, secondary lead smelters, secondary brass and bronze ingot plants, iron and steel plants, and sewage treatment plants. See U.S., Environmental Protection Agency. "Standards of Performance for New Stationary Sources: Additions and Miscellaneous Amendments." 39 Fed. Reg. 9308-23 (March 8, 1974).

[2] Clean Air Act of 1970, § 112(d)(1), 42 U.S.C.A. § 1857c-7(d)(1) (Supp. 1976).

Several studies have estimated the effects of NSD on energy development and economic growth. The most extensive of these have examined impacts on electric utilities, particularly the construction of coal-fired electric generating plants. Both EPA and the Federal Energy Administration (FEA) have undertaken studies in this area.[1] In addition, the utility industry has undertaken studies of its own through the National Economic Research Associates (NERA).[2]

Each of these studies have assumed a national energy growth rate of 5-6 percent in demand for electricity between 1975 and 1990. Interpretation of Congressional requirements for "best available control technology" (BACT) vary with each study. In the most extreme interpretation, stack gas scrubbers would be required for all new power plants. Both EPA- and FEA-sponsored analyses assume this strict, universal scrubber requirement. NERA presents two cases: a "strict BACT" that assumes that both scrubbers and low-sulfur coal will be required, and a "most probable" case that corresponds to current EPA New Source Performance Standards. None of the studies incorporates the potential effects of buffer zones.

Table 14-3 summarizes some of the preliminary findings of these three studies of likely NSD impacts on electric utilities. As shown, the findings of EPA and NERA are more similar than those of FEA with respect to increased consumer costs and increased capital costs for utility companies. FEA's projected impacts for these two categories are minimal, especially given the 1990 time frame. The studies show very different estimates of reduced SO_2 emissions resulting from NSD, with the largest reduction (46 percent) projected by the NERA "strict" case. This is about twice the reduction projected by EPA (18 percent) and over three times that projected by FEA (10 percent). Although EPA and FEA studies are based on similar assumptions, they show dramatic differences

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[1] The analysis of projected impacts of NSD on energy development is largely extracted from a working paper prepared for the Science and Public Policy Program-Radian Research Team by Pamela Baldwin entitled "Non-Significant Deterioration and Western Energy Development" (June 7, 1976).

[2] These studies were unpublished as of December 1, 1976.

TABLE 14-3: IMPACTS OF NON-SIGNIFICANT DETERIORATION ON ELECTRIC UTILITIES

Study[a]	Impacts: 1975-1990			
	Increased Capital Costs for Utilities	Increased Consumer Costs	Demands for Low-Sulfur Western Coal	Reduced Sulfur Dioxide Emissions[b]
EPA	2.6% ($11.4 billion)	2.3% ($28/household/year)	5% (35 MMtpy)	16%
FEA	1.4% ($6.5 billion)	0.7% ($8/household/year)	25% (175 MMtpy)	10%
NERA "Strict"	2.2% ($10.7 billion)	3.7% ($47.87/household/year)	34% (246 MMtpy)	46%
NERA "Most Probable"	2.1% ($10.4 billion)	2.7% ($34.82/household/year)	17% (+73 MMtpy)	35%

EPA = Environmental Protection Agency
FEA = Federal Energy Administration
MMtpy = million tons per year
NERA = National Economic Research Associates

[a] These studies are: (1) U.S., Environmental Protection Agency. *A Preliminary Analysis of the Economic Impact on the Electric Utility Industry of Alternative Approaches to Significant Deterioration*. 1976. Unpublished; (2) ICF, Inc. *Impact of Proposed Non-Significant Deterioration Provisions*, draft Interim Report for U.S. Federal Energy Administration. 1976. Unpublished; and (3) National Economic Research Associates, Inc. *Estimated Costs for the Electric Utility Industry of Non-Significant Deterioration Amendments Currently Considered by the U.S. Senate*. New York, N.Y.: National Economic Research Associates, Inc., 1976.

[b] These projected reductions are calculated compared to New Source Performance Standards, not to the case of no controls.

in projected demands for low-sulfur coal; that is, a 5-percent decrease (EPA) compared to 25-percent decrease (FEA).

Note that these are preliminary findings, based on several assumptions about possible Congressional action on NSD legislation. They suggest that proposed NSD legislation and/or strict enforcement of NSD requirements would not, by themselves, introduce major impediments to western energy development, nor would they burden the economy or consumer with significant cost increases.

The NSD issue raises many related problems, the most fundamental of which appears to be whether or not strict air pollution control is compatible with growth and energy development. If the two are assumed to be compatible, or at least reconcilable, NSD may raise further questions about incentives for pollution control technology over the short term, interstate cooperation to cope with regional pollution, and whether or not government should further subsidize the costs of developing new air quality control technologies. Moreover, disagreement continues over specific issues in the definition of NSD, such as the incorporation of pollutants other than SO_2 and particulate matter.

14.4.4 State-Federal Relationships

The implementation and enforcement of air pollution standards raise the potential for conflict between EPA and the states. For nearly all categories of air pollution control, states implement and enforce either their own regulations or those developed by EPA. EPA retains ultimate responsibility for insuring that national standards are met and for supervising state implementation plans and enforcement programs. This dual system raises questions of how much coordination exists between the states and EPA and how much control EPA may exert over the states. These questions are raised largely because of the explicit desire by the Congress to delegate authority and discretion to the states to address the peculiarities of their own air pollution problems.

EPA appears to have three enforcement options in dealing with states that the administrator feels are inadequately implementing or enforcing air quality regulations. One option is to disapprove state plans and ask for revisions. In July 1976, EPA notified 45 states to revise their implementation plans and incorporate more stringent regulations for one or more pollutants. States were asked to revise their plans by July 1, 1977 for "all achievable emissions limitations" (i.e., those which require reasonable technological additions). The eight states in this study and the pollutants for which they must revise their plans are listed in Table 14-4. Of the eight states, only North Dakota's plan was accepted, although South Dakota, Utah, and Wyoming were required to revise their plan only for particulate emissions.

TABLE 14-4: POLLUTANTS FOR WHICH WESTERN STATES MUST REVISE THEIR IMPLEMENTATION PLANS

State	Pollutants				
	TSP	SO_2	CO	O_x	NO_2
Arizona			X	X	
Colorado	X		X	X	X
Montana	X	X			
New Mexico	X	X	X		
North Dakota					
South Dakota	X				
Utah	X				
Wyoming	X				

CO = carbon monoxide
NO_2 = nitrogen dioxide
O_x = photochemical oxidants
SO_2 = sulfur dioxide
TSP = total suspended particulates

Source: Bureau of National Affairs. Environment Reporter, Current Developments, Vol. 7, No. 10 (July 9, 1976), p. 435.

With respect to enforcement programs, EPA is more constrained in seeking state revisions. In 1975, the Supreme Court ruled that as long as a state plan and regulatory activities maintain national ambient air standards, EPA may not interfere in the enforcement program.[1]

A second option for EPA under the CAA is to take over state plans if it determines that those plans are inadequate to meet the objectives of the CAA or the standards developed to enforce those objectives. In August 1976, after having disapproved several plans submitted by Ohio to control SO_2 emissions, EPA exercised its option to develop a plan for the state.[2] However, assumption of state plans is probably a very limited option because EPA's resources are too limited to allow them to assume development control for more than a few states.[1]

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[1] Train v. NRDC, 421 U.S. 60 (1975).

[2] 41 Fed. Reg. 36324-40 (August 27, 1976).

A third enforcement lever is EPA's administration of program grants, which can be used to create positive incentives for states to develop plans that meet EPA approval. In practice, this monetary sanction and/or incentive is given to EPA regional administrators who allocate funds to state or local governments in their region. Program grants can be as much as three-fourths federal.

An example of problems that can be created by the current system of air pollution control emerged from the impact analyses. We found that, in sparsely populated areas, ambient ground-level concentrations of particulates, nitrogen oxides, and hydrocarbons produced by urban development can be as high or higher than those produced by energy facilities themselves.[2] These high concentrations result from the release of pollutants at low levels in urban areas by such sources as automobiles and home heating. These concentrations do not increase consistently as urban population increases but rather increase rapidly as the total urban population increases to 15-20 thousand and at a progressively slower rate thereafter. Thus, small or new towns in the West are likely to experience a large increase in ambient pollutant levels as population increases, while larger towns will experience relatively little change.[3]

Also, the more labor intensive a technology, the larger the population increase that can be expected. For small towns, this becomes an important air quality consideration. Moreover, it highlights a weakness in the current system of pollution control; that is, state and local governments have virtually no control over mobile sources of pollutants and yet are responsible for meeting ambient air standards that can be violated largely because of the effects of automobile pollution.

14.4.5 Emission Control Systems

Conflicts over the application of different technologies to meet pollution standards constitute a third air quality policy issue. Controversies about emission control technologies are directly related to energy demand, economic costs of production, and interpretation of the CAA. However, they also influence other important air quality problems, including plume visibility, regional pollution, and PSD. Hence, determining which techniques must be applied for emissions control is likely to influence and depend on other air quality issues.

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[1] For an elaboration of this point, see: Thomas, Robert D. "Intergovernmental Coordination in the Implementation of Natural Air and Water Pollution Policies." Paper delivered at the 1974 annual meeting of the American Political Science Association, Chicago, Ill., August 29-September 2, 1974.

[2] This was the case for most of site-specific scenarios. Refer to Section 3.2 for a summary of these findings.

[3] See Section 3.2 for an explanation of how these conclusions were reached.

One controversy related to controlling power plant emissions concerns whether or not flue gas desulfurization equipment (stack gas scrubbers) should be a required technology for new facilities. This issue has assumed increased importance as the alternative of burning fuels with lower sulfur content has become less viable because of diminishing supplies of natural gas and more costly oil. Thus, attention has focused on methods enabling the energy industry to burn dirtier fuels while still meeting ambient air standards. The choices have been narrowed principally to the use of scrubbers capable of removing approximately 90 percent of SO_2 emissions (as well as significant portions of particulate matter) and a combination of dispersive and intermittent techniques.[1] "Dispersive techniques" characteristically means the use of very tall stacks which spread pollutants over a much wider area than do shorter stacks.[2] Although tall stacks do not reduce the quantity of pollutants emitted, they do reduce the concentrations measured at ground level. Used in coordination with "intermittent techniques" that regulate emissions when meteorological conditions dictate, tall stacks can help a facility to meet ambient air standards.

The advantages and disadvantages of the choices are fairly straightforward. Scrubbers reduce total emissions as well as emission concentrations. Tall stacks, generally favored by industry, offer substantial economic savings in comparison with scrubbers.[1]

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[1] See Monnen, L.W., R.E. West, and F. Kreith. "Removal of SO_2 from Low-Sulfur Coal Combustion Gases by Limestone Scrubbing." Journal of the Air Pollution Control Association, Vol. 24 (January 1974). pp. 25-28.

[2] For example, a Georgia state plan called for stacks 800 and 1,000 feet high. See: Ayres, Richard E. "Enforcement of Air Pollution Controls on Stationary Sources Under the Clean Air Amendments of 1970." Ecology Law Quarterly, Vol. 4 (No. 3, 1975), p. 452, footnote 26.

EPA's position is that dispersion from tall stacks over large areas cannot be substituted for control techniques that reduce SO_2 emissions. EPA maintains that sulfates which cause health and visibility impacts may be produced from SO_2; consequently, the total emissions (not emissions density or level of dispersion) must be controlled.

The significance of this choice is underscored by the vast amount of available coal reserves located in the western U.S. Developing these resources is important to both industry and national energy policy. While dispersive techniques may allow this fuel to be used within the limits of ambient air standards, they do not facilitate adherence to PSD requirements. Of course, if PSD requirements are substantially reduced by legislation, the feasibility of tall stacks may be increased, especially for short-term or emergency use.

In spite of a strong industry preference for dispersions rather than scrubbers, recent trends suggest that the issue will be resolved in favor of technologies that reduce total emissions. The Fifth Circuit Court of Appeals ruled against a Georgia State Plan that allowed tall stacks. The court's ruling was that stacks would be permitted only if best available control technologies had been adopted and federal air standards could still not be met.[2] EPA has adopted similar guidelines which also limit the use of tall stacks. In effect, tall stacks cannot be used in place of scrubbers but can be used to meet NSD requirements as long as best achievable technologies are being used.[1]

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[1] One estimate is that stacks cost $1,000 per foot for the first 600 feet and $2,500 per foot each additional foot. Using these figures, a 600-foot stack would cost $600 thousand, an 800-foot stack would cost $1 million, and a 1,000-foot stack would cost $1.6 million. See Doyle, F.J., H.G. Bhatt, and J.R. Rapp. *Analysis of Pollution Control Costs*. Washington, D.C.: U.S., Environmental Protection Agency, 1974, p. 306. The cost of scrubbers depends on such factors as plant size, type of scrubber, and coal characteristics. For a limestone scrubber on a 3,000-MWe plant, total capital costs will probably range from $51 million to $195 million, and annual operating costs from $15.8 million to $57.8 million. Thus, operating costs for 15 years may range from $237 million to $867 million. See: University of Oklahoma, Science and Public Policy Program. *Energy Alternatives: A Comparative Analysis*. Washington, D.C.: Government Printing Office, 1975, pp. 13-23.

[2] *NRDC v. EPA (Georgia)*, 489 F. 2d 390 (5th Cir. 1974). Although this case was reversed on appeal, the issue of tall stacks was not reversed. The Supreme Court implied, in effect, that tall stacks are not responsive to the Clean Air Act. See *Train v. NRDC*, 421 U.S. 60 (1975).

The scrubber issue highlights the interdependence of several issues associated with air quality. Hence, resolution of the "scrubber controversy" probably depends on the larger problems of energy development and environmental protection. The commitment to environmental protection, the availability and costs of imported oil, and resolution of the sulfates and scrubber maintenance questions are likely to determine the extent to which tall stacks are used in the future.

14.5 GROWTH MANAGEMENT

14.5.1 Introduction

Many of the likely impacts of western energy development will initially occur at the local level. On the one hand, small towns and rural communities can be expected to benefit from such development in several respects; for example, employment will increase, local workers may be trained for skilled labor, and the local economic base will be expanded. On the other hand, negative local impacts will occur almost immediately when either large-scale new energy projects are initiated or existing energy facilities are greatly expanded. As discussed in Chapters 6-12, many of these problems arise as a consequence of population growth which, even if anticipated, is almost always uncertain as to length, rate, and magnitude.

Problems associated with the efforts of public institutions in western communities to manage growth are discussed in this section. Experience has shown that when growth is gradual, many communities are able to keep up with demands for increased services; that is, sufficient time and resources exist for determining priorities among needs, planning and response systems can be developed, and sources of assistance can be identified and accessed.[2] However, when growth and development are rapid, several problems arise that may impede a community's reactions to increased service needs. This section discusses four categories of such problems and some of the responses available to communities for coping with them: intergovernmental relations, institutional capabilities, taxation, and assistance programs.

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[1] 41 Fed. Reg. 7450-52 (February 18, 1976).

[2] For example, because of a moderate growth rate followed by a stable permanent population, the quality of life in Idaho Falls, Idaho (with development of the National Reactor Testing Station) appears to have been "enhanced". See University of Denver, Research Institute. The Social, Economic, and Land Use Impacts of a Fort Union Coal Processing Complex, Draft Copy, Appendix A, for the U.S. Energy Research and Development Administration, Fossil Fuels. Springfield, Va.: National Technical Information Service, 1975. FE-1526.

14.5.2 Intergovernmental Relations

A. Problems and Constraints

Local and county governments must deal with problems and issues within the legal powers granted and limits imposed by their states. In many cases, controls and regulations that local governments need to deal with energy development-related changes are constitutionally prohibited. For instance, existing tax laws (debt ceilings and limits on tax rates) often limit the ability of localities to finance needed community facilities.[1] The Utah constitution prohibits the transfer of state revenues, including impact aid, to cities, counties, or Indian tribes. Some states also restrict the freedom of local governments to require a developer to provide some kinds of public facilities, thus limiting the alternatives available to a community when it attempts to solve its growth-related problems.[2]

Another problem is the fragmentation of authority and responsibility for natural resource development. In most states, authority and responsibility are shared by cities, counties, councils of governments, special districts, and state agencies. In turn, each of these governmental units distributes administrative authority among its own various agencies and departments. Occasionally, these institutions may pursue conflicting goals or have overlapping authority. In such a fragmented system, the capacity of any one governmental unit to respond effectively to problems and issues is often constrained or weakened to the point that no adequate response can be implemented.[1]

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[1] As noted in Chapter 11, existing debt ceilings in Beulah and Hazen, North Dakota are not adequate if these localities are to cope with projected fiscal demands. Increasing the debt limit for public projects generally requires a constitutional amendment and a majority vote of the people of the local jurisdiction. And in some cases, the additional allowable increment is small (e.g., the indebtedness limit in Beulah and Hazen can only be raised an additional 3 percent by referendum).

[2] Kutak, Rock, Cohen, Campbell, Garfinkle & Woodward. *A Legal Study Relating to Coal Development--Population Issues*, Vol. I: *Responding to Rapid Population Growth*, for the Old West Regional Commission, Omaha, Neb.: Kutak, Rock, Cohen, Campbell, Garfinkle & Woodward, 1974, pp. 77-78.

A third problem among governmental units is that the costs and benefits of energy development are often unequally distributed. For example, employees associated with the Decker mine in southern Montana live in nearby Sheridan, Wyoming where their impact is felt in terms of housing, water, sewers, and schooling needs. However, none of the tax revenues normally generated by the mine through property or severance tax receipts accrue to Sheridan. Conversely, because of their size, many school districts and county governments are expected to experience immediate revenue surpluses from energy development, as is the case for Campbell County in the Gillette scenario (see Section 9.4).

B. Responses

Several alternatives to characteristic patterns of intergovernmental relationships have been suggested or tried in the eight-state study area. City-county consolidation is one option for more efficient government for situations in which revenue surpluses occur in one jurisdiction (e.g., a county) while expenditures for services and facilities are needed in another (e.g., a city). However, consolidation appears to have little support in the West, largely because of the pervasive split in local leadership attitudes between county commissioners, who are predominantly ranchers, and town officials, whose primary concern is local economic growth. Rural leaders generally believe that consolidation will lend additional weight and leverage to urban needs and thus hasten the shift to rural industrialization.[2]

Special districts that finance, construct, and operate a particular service (e.g., sewage treatment) are a form of city-county cooperation which stops short of consolidation.[3] The advantage of special districts is that they can be used to side-step constitutional prohibitions on debt ceilings and limits on revenue transfers. Their disadvantage is that they offer no guarantees regarding the extent of cooperation between the city and county. For example, the city may back a special district financially while the county assumes no liability for the debts of the special district.[1] This is the situation that exists with the Gillette-Campbell County Joint Powers Board, a special water supply district for Gillette, Wyoming.

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[1] Task Force on Institutional Arrangements, Final Report, for Rocky Mountain Environmental Research, Quest for a Future. Logan, Utah: Utah State University, RMER-Quest, 1974, p. II-C-1.

[2] Allen, Edward H. Growth Management in Western Energy Development Areas: The Uses of State and Local Taxation Tools, prepared as a background paper for the Science and Public Policy Program-Radian Corporation research team. Norman, Okla.: University of Oklahoma, Science and Public Policy Program, 1976, p. 13.

[3] For example, the Wyoming Joint Power Act allows special districts for sewage treatment, recreation, and public school facilities. See Wyoming, State Legislature. Interim Report and Recommendations, Legislative Select Committee on Industrial Development Impact. 1974.

A third approach to improved intergovernmental relationships is coordinated planning units such as councils of governments (COG's).[2] While many states have developed COG's or similar planning units, Utah has advanced the concept by combining this level of planning unit with other institutional mechanisms.[3]

Utah's seven associations of government (AOG's), composed of multi-county planning districts, are primarily concerned with identifying significant local issues, appropriate funding sources, and the feasibility of programmatic responses. However, each AOG also sends representatives to the Governors' Advisory Council on Local Affairs to coordinate local involvement in the state government planning process. The AOG and Governors' State Planning Advisory Committee serve additionally as state and area clearinghouses under the federal Office of Management and Budget A-95 review procedures.[4]

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[1] Allen, Edward H. *Growth Management in Western Energy Development Areas: The Uses of State and Local Taxation Tools*, prepared as a background paper for the Science and Public Policy Program-Radian Corporation research team. Norman, Okla.: University of Oklahoma, Science and Public Policy Program, 1976, p. 13.

[2] Much of the impetus for COG's came from federal legislation which required such processes as "areawide review" and A-95 "review and comment" as part of the granting process.

[3] Information on the Utah intergovernmental planning structure is summarized mainly from Utah, State Planning Coordinator and Department of Community Affairs. *Intergovernmental Planning Coordination: The Utah Experience*. Salt Lake City, Utah: State of Utah, 1975.

[4] A-95 review procedures derive from Section 7 of Office of Management and Budget Circular No. A-95 (January 2, 1976; 41 CFR 2052). A-95 requires states to provide the opportunity for governors and local officials to comment on applications for federal funds to undertake a variety of categorical programs, and requires agencies of the federal government to consider the comments of the general public in approving specific applications for funds.

14.5.3 Planning

A. Problems and Constraints

Many communities and most state governments in the eight-state study area have begun to respond to the problems associated with rapid growth in such ways as upgrading existing mechanisms for coordinating state-county-community planning. However, the effort to develop planning capacities commensurate with the challenges of rapid growth faces several barriers. As indicated in Chapters 6-12, most western communities impacted by energy development have only part-time governmental units, little or no technical or administrative staff, and only a limited planning capacity or experience. Of 131 communities in Federal Region VIII expected to be impacted by energy development by the year 2000, 9 percent have professional planners, 6 percent have full-time city engineers, and only 3 percent have city managers.[1]

Uncertainty associated with energy development also impedes planned responses. Some uncertainty arises from lack of information about the community; more can be attributed to the inconsistent nature of lack of information regarding the plans and policies of energy industries, surrounding towns and states, and the federal government.[2] The indefiniteness of energy development has been exacerbated by the delay or cancellation of many energy projects during the past few years. Even if a town and/or a developer anticipates probable impacts and potential remedies, concrete action often depends on several uncertainties inherent in the process, including approval of Environmental Impact Statements, permits, and leases. For example, the least time necessary to acquire land from the Bureau of Land Management (BLM) is 18 months. Even if a developer is willing to gamble on acquiring land prior to final approval, he is prevented by law from doing so. For example, if BLM released the land, even through Private Exchange, this would still be a "federal action" and prohibited before final approval of the Environmental Impact Statements.

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[1] Mountain Plains Federal Regional Council, Socioeconomic Impacts of Natural Resource Development Committee. *Socioeconomic Impacts and Federal Assistance in Energy Development Impacted Communities in Federal Region VIII*. Denver, Colo.: Mountain Plains Federal Regional Council, 1975.

[2] For a discussion of community information needs to enhance planning, see White, Gilbert, and Gottfried Lang. "Community Mobilization for Adaptation to Change in Rapid Growth Areas," pp. 76-81 in Federation of Rocky Mountain States. *Energy Development in the Rocky Mountain Region: Goals and Concerns*. Denver, Colo.: Federation of Rocky Mountain States, 1975.

Planning difficulties can also be attributed to national and international uncertainties. These include questions about the future of the energy industry in the U.S., such as the relative prices of energy minerals, energy extraction and processing technologies, federal energy policy, and international influences affecting the industry.

A third barrier to adequate planning is the widespread attitude that planning represents "governmental control" and, hence, threatens many important values, including the right of people to do what they want with their own land and to live an independent life. Indeed, the traditional rural attitude toward planning is one of antipathy.[1] However, as the impacts of rapid energy development are actually experienced, the need for governmental response may be increasingly recognized.

B. Responses in Land-Use Planning

Although land-use planning is only one component of the planning needs faced by local communities, measures available to control land use are in many respects typical of the opportunities and problems communities have for dealing with rapid growth. Historically, wide-ranging authority has been delegated by states to localities to deal with land-use problems. In addition to local responses to land-use control, additional state land-use policies and federal assistance programs are outlined below.

1. Traditional Local Responses

Zoning has been the primary tool for localities to control land-use development for most of this century.[2] Zoning can be used to control development, ranging in degree from preventing any development to promoting maximum development, and to direct the nature of development. For example, some lands may be used for only residential purposes, while others may be designated for commerical, agricultural, or industrial purposes.

Local governmental units traditionally have discretionary authority well beyond mere land classification. They also may legislate against public nuisances, adopt subdivision regulations and building codes, institute solid waste management plans and regulations, acquire open space, apply floodplain management regulations and environmental controls, and establish housing or redevelopment commissions or authorities.[1] Separately or in combination, these powers serve as the mechanisms to control the timing and mitigate the social costs of municipal growth.

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[1] See Christiansen, Bill, and Theodore H. Clack, Jr. "A Western Perspective on Energy: A Plea for Rational Energy Planning." Science, Vol. 194 (November 5, 1976), pp. 578-84.

[2] This trend dates to the 1920's and the Department of Commerce's Standard City Planning Act and the Standard Zoning Enabling Act.

However, in the western states, land-use controls have been applied unevenly, and the inadequacy of traditional zoning concepts to deal with energy development is becoming increasingly obvious to many communities. Primary problems include: no or inadequate zoning ordinances at the outset of a growth situation;[2] use zoning which creates economic incentives against the successful implementation of the desired development patterns;[3] and amendments and "spot zoning" which occur when communities are faced with pressures from a tremendous population influx. For example, if two similar parcels of land are zoned for different purposes, one for multi-family and the other for single-family dwelling units, and if the price of the land zoned for multi-family dwellings is substantially higher because multi-family development is more profitable, a prospective developer of multi-family units has an incentive to buy the land zoned for single-family dwellings and use his influence to get the zoning designation changed.[4] This kind of rezoning can lead to immediate and long-term impacts on a locality's development. Hence, variances originally intended to serve as emergency safety valves in unique situations often become the rule.

2. Alternative Zoning Techniques

Planned unit development (PUD) and special purpose districts are two zoning techniques that can help planners deal more effectively with energy-related growth. The PUD technique, which is characteristically used for suburban development, combines compatible uses into a unit while relaxing standard restrictions according to a development plan. Within the total density limits imposed by local zoning ordinances, a builder is permitted to vary densities throughout a unit. Thus, the builder operates within an overall limitation rather than being required to distribute development evenly over the whole unit as would usually be the case.[1] This approach can reduce sprawl, as well as building and housing costs, and can preserve larger areas of open space for recreational and other service uses. Since both space and capital can be problems in western energy development areas, especially during the project construction phase, PUD may be an attractive alternative to traditional patterns of housing subdevelopment.

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[1] Relevant state statutes for these examples are given in White, Michael D. "Constitutional Derivation and Statutory Exercise of Land Use Control Powers," in Rocky Mountain Mineral Law Foundation. *Rocky Mountain Mineral Law Institute: Proceedings of the Twenty-First Annual Institute*, July 17-19, 1975. Albany, N.Y.: Matthew Bender, 1975, pp. 695-97.

[2] Kutak, Rock, Cohen, Campbell, Garfinkle & Woodward. *A Legal Study Relating to Coal Development--Population Issues*, Vol. I: *Responding to Rapid Population Growth*, for the Old West Regional Commission. Omaha, Neb.: Kutak, Rock, Cohen, Campbell, Garfinkle & Woodward, 1974, pp. 77-78.

[3] U.S., Council on Environmental Quality. *Environmental Quality*, Fifth Annual Report. Washington, D.C.: Government Printing Office, 1974.

[4] McCahill, Ed. "Stealing: A Primer on Zoning Corruption." *Planning*, Vol. 39 (December 1973), pp. 6-8.

A second alternative is the special-purpose district. Like PUD, special districting is designed to permit departures from the one-use, single-lot approach to zoning and to be more responsive to public opinion. In general, special districts are formed to protect desirable uses in a specific area of social, cultural, or historical importance that are threatened by redevelopment.

3. State-Level Responses

Even though the PUD and the special service district may facilitate community control over rapid development, local land-use efforts are seldom adequate to cope with statewide (and ultimately regional or national) impacts. Thus, many western states have further regulated the planning process.[2] Wyoming and North Dakota now require local governments to adopt subdivision regulations, appoint planning commissions, and engage in comprehensive planning. Colorado and Wyoming have state land-use commissions. Colorado's Land Use Commission provides a technical assessment of the adequacy of environmental impact statements and compliance with state standards. The Wyoming Land Use Administration is responsible for planning in geographic areas that have been identified as critical in terms of large-scale development. Although not identical in function, neither agency has much enforcement power.[1]

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[1] See Huntoon, Maxwell C., Jr. *PUD: A Better Way for the Suburbs*. Washington, D.C.: Urban Land Institute, 1971. When PUD is used, the developer and local planning board work out a mutually agreeable plan for each development.

[2] Efforts by states to deal with land-use problems on a statewide or regional basis generally recognize the important role played by local governments closest to the problem; that is, they are not intended to usurp local responsibility or participation. Rather, they result from the increasing awareness, on the part of all parties concerned, that many of the problems facing communities are simply beyond the scope and capacity of limited local staff and jurisdictions. The 1972 Montana constitution mandated a 3-year study (1975-77) to determine how local governmental units or combinations of units can become more effective. The study is also to analyze and make recommendations about the responsibilities various levels of government should assume regarding planning and land-use controls.

With the exception of one or two states in the western U.S., considerable fragmentation and competition still exist among the state agencies that make planning decisions. Cases of coordination and integration of state efforts with local level planning have been rare. This is likely to assume increased importance as localities are forced to accept both state and federal agency controls which are usually tied to funding and/or technical support. Even when communities oppose the planning philosophy, state and federal legislation regulating pollution and environmental protection is causing them to consider different alternatives.

4. Federal Programs

The federal government exercises substantial land-use control powers, largely through Section 701 of the Housing Act of 1954 which provides assistance to local governments for planning purposes.[2] The principal source of federal financial support for countywide land-use programs is the Department of Housing and Urban Development's (HUD) 701 grants program.[3] One important purpose of the program has been to include the input of urban planners in the effort to shape new and existing communities, which until the mid-1950's had been left mostly to the designers of roads, sewers, and airports.[4]

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[1] Rapp, Donald A. Western Boomtowns, Part I, Amended: *A Comparative Analysis of State Actions*. Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, p. 43.

[2] Housing Act of 1954, 68 Stat. 590, 40 U.S.C.A. § 461 (Supp. 1976).

[3] 1975 funding levels from the 701 program ranged from \$270 thousand (Wyoming) to \$1.5 million (Colorado) among the six states of Federal Region VIII.

[4] Reilly, William K. "National Land Use Policy," pp. 1415-1465 in Dolgin, Erica L., and Thomas G.P. Guilbert, eds. *Federal Environmental Law*. St. Paul, Minn.: West, 1974.

HUD established interim regulations in 1974 for recipients of 701 funds after August 22, 1977.[1] It has been suggested that these regulations represent an attempt on the part of HUD to "corner the market" in federal land-use matters.[2] Since Congress has yet to agree on national land-use legislation, the HUD 701 provisions to some extent fill a statutory void.

Section 701 requires grant recipients to carry out an ongoing "comprehensive planning process" that contains mutually consistent housing and land-use elements in line with national growth policy objectives. The housing element objective is to promote the goal of a decent home and suitable living environment for every American family; the land-use element is intended to coordinate governmental land-use policies and plans so that they serve as a guide to decisionmaking on all related matters. The regulations are also designed to facilitate coordinated land-use policies among the various levels of government. The meaning of these provisions to states that do not have land-use commissions is not clear. However, if states are to continue receiving 701 funds, they must, as a minimum, develop stronger planning programs with more efficient integration among levels of government.

The Flood Disaster Protection Act of 1973 similarly establishes national interests with regard to land use.[3] This act denies any federal assistance for construction in flood-prone areas unless communities implement HUD-approved land-use plans for such areas. As of July 1, 1975, federally licensed, regulated, or insured banks and savings and loan institutions were to cut off all assistance (mortgage loans) to communities identified by HUD as having special flood hazards but which had not entered HUD's insurance program. To enter the program, communities must agree to develop land-use control measures which are consistent with HUD's floodplain management criteria. These criteria require the enactment of floodplain ordinances, including zoning and building code provisions in hazardous areas. More restrictive controls may be demanded pursuant to more specific information about the potential flood problems in a given area.

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[1] U.S., Department of Housing and Urban Development, Office of Community Planning and Development. "Comprehensive Planning Assistance, Interim Regulations." 39 Fed. Reg. 43378-87 (December 12, 1974). (Revised regulations promulgated at 40 Fed. Reg. 36856-65) (August 22, 1975).

[2] Bureau of National Affairs. Environment Reporter, Current Developments, Vol. 5, No. 35 (December 27, 1974), p. 1327.

[3] Flood Disaster Protection Act of 1973, Pub. L. No. 93-234, 87 Stat. 975 (codified at 12 U.S.C.A. §§ 24, 1709-1; 42 U.S.C.A. 4001-3, 4012a, 4013-4016, 4026, 4054, 4056, 4101, 4104-4107, 4121, 4128)(Supp. 1976).

Thus, with respect to land use, the trend appears to be clearly toward increased assertion of federal interests in land-use control, even though no national land-use legislation has been enacted. Moreover, this trend is likely to continue as particular land-use conflicts become irreconcilable at lower levels of government.[1]

14.5.4 Taxation Tools

The power to levy taxes gives western state and local governments a tool for both raising revenues and controlling growth. Some tax programs are more appropriate for one of these purposes than the other; if any tax controls grow to the point of discouraging development, revenues will eventually decline.

Increased public revenues in energy-impacted areas can be used in a number of ways, including providing the governmental facilities and services needed by an expanded population, catching up on a backlog of public projects,[2] reducing tax rates, and diversifying growth from the energy industry into other, longer-lived industries. Generally, the first of these goals presents local government with the most urgent challenges. As shown by the fiscal analyses reported in Part II, energy-impacted areas gain substantial long-term financial benefits from development, but tax needs are frequently out of phase with revenue flows. In some instances, tax monies are needed before they would become available, while in others the jurisdiction benefiting from the increase (e.g., a county) in tax revenues will not be the one facing greatly increased expenditures (e.g., a city). In some cases, both timing and distribution are problems.

The lead-time problem arises because traditional fiscal measures, such as ad valorem property taxes, often have built-in collection lags. Hence, during the first few years of construction, the value of a new development is not included in the local tax base. Public revenues may not adequately expand for as much as 3 years after the arrival of new workers and their families. Operational activities of local government then claim the bulk of revenues, leaving little, if any, for construction of new facilities, even though construction of some should have been started before the arrival of new people.

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[1] Reilly, William K. "National Land Use Policy," pp. 1415-1465 in Dolgin, Erica L., and Thomas G.P. Guilbert, eds. Federal Environmental Law. St. Paul, Minn.: West, 1974.

[2] The City of Glenrock, Wyoming paved their streets, put in a storm sewer, and built a new town hall. See Allen, Edward H. Growth Management in Western Energy Development Areas: The Uses of State and Local Taxation Tools, prepared as a background paper for the Science and Public Policy Program-Radian Corporation research team. Norman, Okla.: University of Oklahoma, Science and Public Policy Program, 1976, p. 16.

The most viable options for communities facing a construction boom are new or increased tax rates, new public debt, or "muddling through" the short-term until revenues catch up with expenditure needs. However, elected officials often face political constraints which may inhibit or block attempts to increase taxes.

Indeed, some policymakers exhibit a compulsion to avoid general tax increases to the point of bypassing urgent public needs.[1] As a result, communities often adopt short-term strategies to cope; that is, they try to suffer through the lean years, looking toward the time when new revenues will be available. Although this strategy may appear simply to deny the existence of a problem, it may well have merit if a construction boom is expected to be short-lived or if the level of development is too uncertain to begin remedial action. In such a case, the community will not need permanent facilities to match the boom-period population. Building to meet boom needs would leave excess capacity later.

Local governments may seek immediate relief by placing much of the additional tax burden on newcomers. Such taxes are usually justified on the grounds that the newcomers are the ones imposing new costs for expanded capacity. Sewer and water line connection fees are the ones most easily levied directly on newcomers, but the revenues that can be raised from these sources are clearly limited. Thus, old-timers must share in some of the increased costs, at least indirectly. However, developing a taxation system that is equitable for both new and old residents is difficult.

Municipal bond markets may be tapped to temporarily supplement tax revenues if future budget surpluses are anticipated. The principal limitations are legal, political, and financial: state constitutions and statutes often specify debt limitations (see Section 14.5.2); long-term bonds for capital expansion are not readily approved by long-time residents who may prefer things as they are; and buyers in a national bond market may distrust the credit status of small communities.[1] Municipalities have sometimes responded to these limitations by creating special financing districts; however, this trend often adds to problems of intragovernmental fragmentation, lack of cooperation, and accountability.[2] Special service districts, county service districts, and joint city-county districts may in fact generate the necessary capital for front-end financing, but in creating numerous political subdivisions, local officials may actually further impede efforts to coordinate overall community planning.

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[1] For a discussion of the political barriers that local elected and appointed officials confront regarding taxation, see Ecker-Racz, L.L. The Politics and Economics of State-Local Finance. Englewood Cliffs, N.J.: Prentice Hall, 1970, pp. 15-27.

Despite these problems, the analysis of hypothetical energy developments in Part II has shown that the facilities can be expected to generate revenue surpluses sometime during the lifetime of the project. For example, the developments at both Forsyth, Montana and Gillette, Wyoming are expected to produce substantial surpluses within 5-10 years after development begins. Taxable investments in a mine and minerals production will more than make up the overall tax needs if allocations from higher levels of government are returned to the impacted areas. The strategy here is to move the center for tax collection and distribution to the state. Then the state can redistribute funds from those communities that are well into the energy production phase to those communities that are just beginning to feel construction-phase impacts.

Along with new state-level taxes, both Montana and Wyoming have created special legislative programs for local fiscal imbalances caused by coal development. Although these programs are the exception in the study area, they provide options that other states facing rapid energy development may wish to consider. The major objectives of these programs are to provide for the prepayment on request of property taxes before a new facility is constructed (Montana),[3] to give local governing bodies the ability to borrow against anticipated future tax revenues, and to grant extensions for repaying borrowed monies (Wyoming).[4]

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[1] U.S., Department of Housing and Urban Development, Office of Community Planning and Development. Rapid Growth from Energy Projects: Ideas for State and Local Action, A Program Guide Washington, D.C.: Government Printing Office, 1976, p. 30.

[2] Council of State Governments. State Growth Management, prepared under the direction of the Office of Community Planning and Development, U.S. Department of Housing and Urban Development. Washington, D.C.: Government Printing Office, 1976, p. 28.

[3] Montana Revised Codes Annotated, § 84-301 (Cumulative Supplement 1975).

[4] Wyoming, State Legislature. Interim Report and Recommendations, Legislative Select Committee on Industrial Development Impact. 1974.

The principal state-level minerals taxes are the ad valorem property tax, severance and conversion taxes, and the performance guarantee.[1] Ad valorem taxes were historically the first taxes levied on mines and mineral properties, and continue to serve as major revenue producers for most local governments.[2] They treat mining activities the same as other industries; a value is placed on a mineral deposit either by a county or state assessor and the local millage rate is applied to the assessed value. Inherent problems in valuation led Montana and Wyoming to use the annual gross proceeds of a mineral enterprise as the basis of property value, rather than assessing the value of the mineral in place.[3] When the mines are located outside a town's jurisdiction, special programs are needed to distribute funds to the point of social impact.

Severance and conversion taxes can be levied at a set amount per unit of production (such as cents per ton of coal per year) or as a set percentage of the gross value of production. Severance taxes are simpler to administer than ad valorem taxes because they do not involve the inherent assessment problems. Since the tax is based on the physical output of the mining activity, revenues during the early development stages (3-5 years) will probably be well below those needed to finance new service demands. As noted in Chapter 10, unless the available state impact funds generated in that scenario are channeled back to the localities, the fiscal imbalance in the energy development areas could persist for some time. Thus, redistribution actions by the state will be instrumental in determining whether financial problems of communities outside the immediate vicinity of an energy project will be handled adequately.

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[1] The performance guarantee is not, legally, a tax. That feature gives it certain advantages, as described below.

[2] Three sources inadequately tapped during the first year will be used to improve the analysis of taxes during the remainder of the project: Bronder, Leonard D. *Taxation of Coal Mining: Review with Recommendations*. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976. Bronder, Leonard D. *Taxation of Surface and Underground Coal Mining in Western States*. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976; and a study currently under way in the Economic Research Service of the Department of Agriculture on state taxation of mineral deposits and production.

[3] Estimating the value of a mineral deposit requires estimating the amount of mineral reserves, quality of the mineral, depth of overburden, accessibility of markets, and future market prices. It also requires understanding the capital investment in the mine as it relates to the amount of extractable ore. Bronder, Leonard D. *Taxation of Coal Mining: Review with Recommendations*. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, p. 17.

The Wyoming experience provides an example of special severance taxation. In 1974, the Select Committee on Industrial Development Impact of the Wyoming State Legislature determined that an additional $65 million was needed over a span of 5 years to cope with increased highway, road, water, and sewer needs in various parts of the state. The committee also concluded that the burden of paying for needed improvements should be assumed by the coal industry. As a result, the state passed a severance tax that increases from 0.5 percent initially to 2.0 percent of value by 1978. This tax will remain in effect until the state has collected a total of $120 million. At least 60 percent of the monies derived from the tax are dedicated to either local governments or the State Highway Department to be spent on highways and roads in impacted areas. The remaining funds will be made available through a state review board for municipal water and sewer improvements. In addition, the money can be used to match federal grants and can be dedicated to back borrowed funds.

From the state's point of view, one of the obvious advantages of direct mineral taxation is that much of the burden will be shifted out of state, to the mining company and/or its customers. For that reason, developers and their customers may be expected to react both economically and politically. Economically, industry will have an incentive to locate in low-tax states. Conversion taxes in particular may induce companies to opt for strip-and-ship. Politically, consuming states have argued that when almost all of a commodity is exported from a state, the state has no authority under the federal constitution to tax it. Arizona has already challenged New Mexico's electrical generation tax in court on such grounds. Producing states can argue that growth should pay its own way, especially when that growth results from a national policy of promoting domestic production. These questions will have to be resolved before western states can plan on substantial revenues from direct minerals taxation.[1]

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[1] Some of the issues are discussed in Chapter IV, of Nehring, Richard, and Benjamin Zycher. *Coal Development and Government Regulation in the Northern Great Plains*. Santa Monica, Calif.: The Rand Corporation, 1976. R-1981-NSF/RC. Also see Magida, Arthur J., and Richard Corrigan. "Energy Report: Trying to Pull the Plug on Uncle Sam's Energy Plans." National Journal, Vol. 8 (May 8, 1976), pp. 618-25; Corrigan, Richard, and Arthur J. Magida. "Energy Report: The West Readies Itself for the 20th Century 'Boom or Bust'," *National Journal*, Vol. 8 (May 15, 1976), pp. 666-70.

Several recently enacted mineral tax packages[1] are responsive to the need to dedicate specified percentages of the revenues to state and community service needs. The Montana and Wyoming mineral tax legislation also creates the institutional elements to administer these programs. At present, these organizational devices and taxation schemes remain largely untested. However, our western Dakota scenario (Section 11.4.6) indicates that local revenue shortfalls may still exist. Only 1.5 percent of the conversion tax and none of the severance tax is guaranteed to towns. This is probably not enough to meet their increased service demands. Ample funds will go to the county governments and the state's Coal Development Impact Office, so the needs could be met with the cooperation of those agencies.

As an alternative to traditional taxation methods, Wyoming has established an Industrial Siting Council that can attach extensive conditions to its construction permits. For example, in the recent Laramie River power station case, the developer agreed to provide housing facilities and a recreation center, to contract with the county sheriff for plant security guards, and to initiate a socioeconomic monitoring program. The permit procedure sets up a negotiating framework under which the state (on behalf of the locality) can induce the private sector to underwrite quasi-public facilities and services. In effect, the transfer is a tax, but it has several advantages over formal taxes: the burden is focused on the developer, specific needs can be addressed directly, and responses are negotiated and flexible.[2] The agreement on plant security retained a unified police system in the county, while requiring the developer to pay his incremental costs.

As a growth management tool, formal taxation must play a supporting rather than leading role for a number of reasons. First, taxation alone is too unwieldy for dealing with the more specific challenges presented by rapid growth. Second, conflicts often arise over the use of taxes to control growth and their use to raise revenues. Third, the regulation of growth has historically been dealt with locally, while taxation has been controlled by the state.

Finally, the financial innovations used to solve impact problems add to the complexity of the growth management effort by increasing the number of participants in the planning process.

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[1] Those of Montana, North Dakota, and Wyoming.

[2] Allen, Edward H. *Growth Management in Western Energy Development Areas: The Uses of State and Local Taxation Tools*, prepared as a background paper for the Science and Public Policy Program-Radian Corporation research team. Norman, Okla.: University of Oklahoma, Science and Public Policy Program, 1976, pp. 18-21.

Hence, growth management in energy-impacted communities will demand uncommon initiative, cooperation, and coordination among all levels of government.

14.5.5 State and Federal Assistance

Faced with pressing service demands, a shortage of local financial resources, and often lacking growth management planning capacities, communities necessarily seek state and federal assistance. Financial assistance to such communities from state and federal jurisdictions is logical because both are already involved with local government revenues through income taxation, revenue sharing, and other policies and programs. Further, many of the needed construction programs for capital-intensive improvements are mandated by federal law; for instance, the Federal Water Pollution Control Act Amendments[1] of 1972 require stricter pollution control and upgrading treatment facilities to meet new water quality standards. However, application for an access to and can be as problematical for communities as the impacts themselves.

A. State Assistance

Most of the western energy states already have revenue-producing measures relating to the extraction, processing, and conversion of their resources. As noted in Section 14.5.2, each state's constitution and statutes establish the sources of financial aid available to local governments and the limits on their uses. These funds can be generally classified as either locally shared, annually distributed funds or discretionary funds such as grants and long-term loans. Some discretionary funds require matching contributions of money or services, while others simply require an application from a qualified governmental agency. All eight states in this study have a department of local or community affairs which coordinates state services to local governments and administers various programs, including technical assistance and advisory services, assistance on state and federal aid, planning services, and community and resource development. State planning agencies in the study area are listed in Table 14-5.

Several western states have enacted new legislation specifically for energy-impacted communities. For example, Wyoming's Community Development Authority can issue as much as $100 million in tax-free general-purpose revenue bonds to finance housing and other public facilities. South Dakota's Coal Impact Office has the power to offer direct grants-in-aid, and Utah has made provisions for energy industries to prepay sales and use taxes into

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[1] Federal Water Pollution Control Act Amendments of 1972, § 301, 33 U.S.C.A. § 1311 (Supp. 1976).

TABLE 14-5: STATE PLANNING AGENCIES

State	Agency	State Office Administering "HUD 701" Grants[a]
Arizona	Department of Economic Planning and Development	Department of Economic Planning and Development
Colorado	Department of Local Affairs	Colorado Division of Planning
Montana	Department of Community Affairs	Department of Community Affairs
New Mexico	State Planning Office	State Planning Office
North Dakota	State Planning Division	State Planning Division
South Dakota	State Planning Agency	State Planning Bureau
Utah	Department of Community Affairs	State Planning Coordinator (Governor)
Wyoming	Department of Economic Planning and Development	State Planning Coordinator (Governor)

[a] HUD Section 701 grants are made under the Housing Act of 1954, § 701, 40 U.S.C.A. § 461 (1970) to assist statewide and substate planning, including localities, large cities, urban counties, Indian tribal groups or bodies, and metropolitan areawide planning organizations.

a fund dedicated to state-related public improvements. In spite of these programs, many local communities still lack the expertise to process applications, to push stalled applications out of state or federal agencies, to apply programs once they are granted, or to provide follow-up documentation. Thus, the provision of adequate state technical assistance to local staffs is of critical concern.

Recommendations for increased technical assistance usually include the need for close interaction among state policies, programs and regulations; however, there may be few structural mechanisms for coordination among state planning agencies and local planners. As noted in Section 14.5.2., Utah has taken several major steps to remedy this problem by assisting local officials in their use of both state and federal granting processes and procedures. Another possibility is the use of "mobile" state teams of experts (e.g., planners, administrators, etc.) who would be "loaned" to energy-impacted communities to assist local officials in their efforts.[1]

B. Federal Assistance

Localities can seek federal as well as state assistance. Several national programs are available, although not specifically directed to areas impacted by energy development. Moreover, since all communities compete for existing funds, small energy-impacted communities often find it difficult to qualify, complete all application requirements, or otherwise compete.

The two primary mechanisms for federal assistance are: general revenue sharing funds, distributed on the basis of population, local tax effort, and per capita income; and grants-in-aid, distributed for specific public welfare projects, usually according to need. Grants often require matching contributions and set strict performance standards for the recipient. Since grant formulas are usually based on population, land area, or matching contributions, they often discriminate against small communities or sparsely populated rural areas. Further, because they are based on 1970 census estimates, they usually fail to account for recent rapid growth situations.

Table 14-6 lists federal grant and loan sources available through categorical programs in six functional areas: housing; water supply and sewage treatment; hospitals, health facilities, and social services; roads; law enforcement and fire protection;

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[1] The idea of a Technical Assistance Team for local government is explored in Rapp, Donald A. Western Boomtowns, Part I, Amended: A Comparative Analysis of State Actions, Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976.

TABLE 14-6: FEDERAL ASSISTANCE PROGRAMS AVAILABLE TO ENERGY-IMPACTED COMMUNITIES

Community Facility or Service Category	Source of Funds	Title of Program	Uses, Restrictions and Eligibility Requirements
Housing	Economic Development Administration	Economic Development - Technical Assistance	Referred to as "Title IX". Flexible uses. A-95 review required. Requires state plan.
	Farmers Home Administration	Rural Housing Site Loans	A-95 review required.
		Rural Rental Housing Loans	Occupants must be low- to moderate-income families or senior citizens. A-95 review required.
		Rural Self-Help Housing Technical Assistance	Project grants. To help people build homes. Limited to low-income rural families.
		Business and Industrial Development Loans	To improve economic and environmental climate. Flexible. Preference for projects benefiting people living in rural areas and in cities of less than 25,000 in population. A-95 review required.
		Industrial Development Grants	To improve economy of rural areas. Very flexible. A-95 review required.
	Housing and Urban Development (HUD)	Community Development Block Grants/Discretionary Grants	Does not include community facilities. Flexible.
	Other Assistance		Contact HUD for information on mortgage insurance programs.

TABLE 14-6: (Continued)

Community Facility or Service Category	Source of Funds	Title of Program	Uses, Restrictions and Eligibility Requirements
Water Supply and Sewage Treatment	Economic Development Administration	Economic Development-Technical Assistance	Referred to as "Title [illegible]". Flexible [illegible]. A-95 review required. Requires [illegible] plan.
		Economic Development - Special Economic Development and Adjustment Assistance Program.	Profit-making organizations are not eligible. Very flexible. Referred to as "Title [illegible]".
	Farmers Home Administration	Irrigation, Drainage, and Other Soil and Water Conservation Loans	Limited to helping organizations serving residents of open country and rural communities up to 1,500 population. A-95 review required.
		Rural Housing Site Loans	A-95 review required.
		Resource Conservation and Development Loans	To increase economic opportunities for local people. Public agencies and local nonprofit corporations in authorized Resource Conservation and development areas. A-95 review required.
		Water and Waste Disposal Systems for Rural Communities	Guaranteed/insured loans and project grants. Service area must not exceed population of 10,000. A-95 review required.
		Community Facility Loans	Very flexible. Must serve rural people and communities less than 10,000 in population. A-95 review required.
		Industrial Development Grants	To improve economy of rural areas. Very flexible. A-95 review required.

TABLE 14-6: (Continued)

Community Facility or Service Category	Source of Funds	Title of Program	Uses, Restrictions and Eligibility Requirements
Water Supply and Sewage Treatment	Environmental Protection Agency	Construction Grants for Wastewater Treatment Works	Community must be high on state's Priority List. A-95 review required.
	Four Corners Regional Commission	Four Corners Regional Economic Development	Only available to communities in Arizona, Colorado, New Mexico, and Utah. A-95 review required.
	Housing and Urban Development	Community Development Block Grants/Discretionary Grants	Does not include community facilities. Flexible.
	Old West Regional Commission	Old West Regional Economic Development	Only available to communities in Montana, Nebraska, North Dakota, South Dakota, and Wyoming.
	Other Assistance		Contact Federal Disaster Assistance Administration or FHA; Soil Conservation Service and EPA for technical assistance.
Hospitals, Health Facilities and Social Services	Economic Development Administration	Economic Development – Technical Assistance	Referred to as "Title 3". Flexible. A-95 review required. Requires state plan.
		Economic Development – Special Economic Development and Adjustment Assistance Program	Profit-making organizations are not eligible. Very flexible. Referred to as "Title 9".
	Farmers Home Administration	Business and Industrial Development Loans	To improve economic and environmental climate. Flexible. Preference for programs benefiting people living in rural areas and in cities of less than 25,000 in population. A-95 review required.

TABLE 14-6: (Continued)

Community Facility or Service Category	Source of Funds	Title of Program	Uses, Restrictions and Eligibility Requirements
Hospitals, Health Facilities and Social Services		Community Facilities Loans	Very flexible. Must serve rural people and communities less than 10,000 in population. A-95 review required.
	Four Corners Regional Commission	Four Corners Regional Economic Development	Only available to communities in Montana, Nebraska, North Dakota, South Dakota, and Wyoming.
	Health, Education and Welfare (HEW)	Family Planning Projects	Any public or non-profit private entity is eligible.
		Drug Abuse Community Service Programs	Project grants and research contracts.
		Mental Health – Community Health Center	Project grants for construction. Federal share from 1/3 to 2/3 costs.
		National Health Services Corps	Provides for the assignment of health personnel in communities.
		Family Health Center	Very flexible.
		Emergency Medical Services	Very flexible. A-95 review required.
		Alcohol and Drug Abuse Prevention	Project grants for alcohol and drug abuse education.
		Child Development – Head Start	Designed for children of low income families.
		Child Development – Child Abuse and Neglect Prevention and Treatment	Project grants. Flexible.

TABLE 14-6: (Continued)

Community Facility or Service Category	Source of Funds	Title of Program	Uses, Restrictions and Eligibility Requirements
Hospitals, Health Facilities and Social Services	General Services Administration	Disposal of Federal Surplus, Real Property	Flexible.
	Other Assistance		Contact State Health Department for Assistance and Grants
Roads	Economic Development Administration	Economic Development - Technical Assistance	Referred to as "Title I". Flexible. A-95 review required. Requires state plan.
		Economic Development - Special Economic Development and Adjustment Assistance Program	Profit-making organizations are not eligible. Very flexible. Referred to as "Title IX".
	Farmers Home Administration	Rural Housing Site Loans	A-95 review required.
		Community Facilities Loans	Very flexible. Must serve rural people and communities less than 10,000 in population. A-95 review required.
	Four Corners Regional Commission	Four Corners Regional Economic Development	Only available to communities in Arizona, Colorado, New Mexico, and Utah. A-95 review required.
	Housing and Urban Development	Community Development Block Grants/ Discretionary Grants	Does not include community facilities. Flexible.
	Old West Regional Commission	Old West Regional Economic Development	Only available to communities in Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

TABLE 14-6: (Continued)

Community Facility or Service Category	Source of Funds	Title of Program	Uses, Restrictions and Eligibility Requirements
Roads	Other Assistance		Contact Federal Disaster Assistance Administration at HUD.
Law Enforcement and Fire Protection	Farmers Home Administration	Community Facility Loans	Very flexible. Must serve rural people and communities less than 10,000 in population. A-95 review required.
	Forest Service	Cooperative Law Enforcement	Local law enforcement unit must be able to enforce state and local laws on lands within the national forests.
		Cooperative Forest Fire Control	Assistance is available indirectly through state.
	Other Assistance		Contact Law Enforcement Assistance Agency for technical assistance. Contact Bureau of Mines for mine fires. (CFDA No. [illegible])
Recreation	Bureau of Land Management	Public Land for Recreation, Public Purposes and Historic Purposes.	Flexible.
		Small Reclamation Projects	Limited to 17 western-most states. Very flexible.
	Economic Development Administration	Economic Development – Technical Assistance	Referred to as "Title [illegible]". Flexible. A-95 review required. Requires state plan.
		Economic Development – Special Economic Development and Adjustment Assistance Program	Profit-making organizations are not eligible. Very flexible. Referred to as "Title [illegible]."
	Farmers Home Administration	Recreation Facility Loans	To help farmers and ranchers to convert land into recreational facility. Must seek other loans first.

TABLE 14-6: (Continued)

Community Facility or Service Category	Source of Funds	Title of Program	Uses, Restrictions and Eligibility Requirements
Recreation	Farmers Home Administration	Resource Conservation and Development Loans	To increase economic opportunities for local people. Public agencies and local non-profit corporations in authorized resource conservation and development areas. A-95 review required.
		Rural Rental Housing Loans	Occupants must be low- to moderate-income families or senior citizens. A-95 review required.
		Watershed Protection and Flood Prevention Loans	Cannot exceed [illegible] in one watershed. Very flexible. A-95 review required.
		Business and Industrial Development Loans	To improve economic and environmental climate. Flexible. Preference for projects benefiting people living in rural areas and in cities of less than [illegible] in population. A-95 review required.
		Community Facility Loans	Very flexible. Must serve rural people and communities less than [illegible] in population. A-95 review required.
	Four Corners Regional Commission		Only available to communities in Arizona, Colorado, New Mexico, and Utah. A-95 review required.
	Old West Regional Commission	Old West Regional Economic Development	Only available to communities in Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

TABLE 14-6: (Continued)

Community Facility or Service Category	Source of Funds	Title of Program	Uses, Restrictions and Eligibility Requirements
Recreation	Old West Regional Commission	Assistance	Only available to communities in Montana, Nebraska, North Dakota, South Dakota, and Wyoming.
	Other Assistance		Contact Soil Conservation Service, CFDA No. 10.901 and 10.904.[b] Contact National Park Service for Surplus Wildlife.

Source: Information adapted from Rapp, Donald A. Western Boomtowns, Part I. Amended: A Comparative Analysis of State Actions. Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, pp. 58-88 and U.S. Department of Housing and Urban Development. Office of Community Planning and Development. Rapid Growth from Energy Projects: Ideas for State and Local Action, A Program Guide. Washington, D.C.: Government Printing Office, 1976, pp. 35-45.

[a] Term "flexible" indicates the application of the program is broad with respect to what kinds of projects can be funded, who can apply, and/or the financial requirements placed on the applicant.

[b] Program code number from U.S., Office of Management and Budget. Catalogue of Federal Domestic Assistance. Washington, D.C.: Government Printing Office, printed annually.

and recreation.[1] Although a variety of programs exist, many seem beyond the scope of energy-impacted communities. For example, HUD's block grants for community development require detailed 3-year community development plans, needs assessments, specification of goals and programatic responses, and housing assistance plans for low- or moderate-income people. In effect, these requirements go beyond the capacities of most small communities, as discussed in Section 14.5.3.

The "In Lieu of Tax Payments Act" of 1976 and the "Federal Coal Leasing Act" of 1975 provide an exception to the assistance provided by revenue sharing and grants-in-aid. Both laws could provide substantial planning funds for states and small communities. Under the In Lieu of Tax Payment Act, the federal government will pay each local government an amount equal to the tax which would have been due if the federal land in the jurisdiction was privately owned. This may be a significant source for many western counties and school districts simply because so much of the land is federally owned.

The Federal Coal Leasing Act[2] is another source of new money. The act establishes a minimum 12.5-percent coal royalty rate (except for underground mining) and increases the state's share of money from the sale and rental of public lands by 12.5 percent. The act also stipulates that, in the use of these funds, states give priority to the planning, construction of facilities, and public service needs of areas impacted by minerals development.

Many problems with the role of state and federal assistance can be ameliorated through closer cooperation among governmental units. One response to closer cooperation is the Rural Development Service (RDS), which is responsible for coordinating a nationwide development program among executive departments and state and local rural development programs.[3] Towns of less than 10 thousand are defined as rural and towns up to 50 thousand are eligible for some form of assistance. One service provided by RDS is a computer-based catalogue of federal domestic assistance programs. For a minimal cost, communities can receive a printed list of information on programs, given specific needs or eligibility criteria. The information base is updated monthly and, for many communities, may expedite the application process.

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[1] For a detailed description of the more than 1,200 federal aid programs, see U.S., Office of Management and Budget. *Catalogue of Federal Domestic Assistance*, Washington, D.C.: Government Printing Office, printed annually.

[2] Federal Coal Leasing Amendments Act of 1975, § 9, amending 30 U.S.C.A. § 191, (Supp. 1976).

[3] Established under section 603 of the Rural Development Act of 1972, § 603, 7 U.S.C.A. § 2204a (Supp. 1976).

During the remainder of this study, more attention will be given to the issue of federal impact laws. Still uncertain is whether or nor energy-impacted areas can be legally interpreted as resulting from national policies and objectives.[1] Direct discretionary funds for energy-impacted communities have not been appropriated by Congress, although the 1976 revision of the Mineral Leasing Act does make federal funds available to many western states, provided they be used to ameliorate the impact of energy development. The critical role that aid plays in almost every energy-impacted community is discussed further in the sections on housing (14.6) and specific facilities and services (14.7).

14.6 HOUSING

14.6.1 Introduction

The lack of sufficient housing to accommodate increased population is perhaps the most widespread problem encountered by energy development-impacted communities. This section includes a discussion of factors influencing housing type and construction technique, temporary and permanent housing options, the choice of public or private provision of housing, and sources of financing.

The problem of housing in energy-impacted communities is compounded by market constraints and the need concurrently to provide other local facilities and services. Except for some fairly recent federal programs for low- and moderate-income families, housing has been provided almost exclusively by the private sector. The housing industry's desire to recover a reasonable return on investment is often at odds with the timing and level of housing demand in energy-impacted communities. Specifically, higher demand during the construction phase will generally not be met by local developments of permanent housing. Other local facilities necessary for housing developments, such as streets, sewers, and water, will also tend to be deemphasized during a temporary boom.

In short, public as well as private sector decisions are involved in local housing. Uncertainty regarding the timing and magnitude of future development of energy resources is among the primary reasons for housing needs not being met during boom situations.

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[1] Energy impact fund legislation for $1 billion worth of loans and local guarantees is pending in Congress (S 3007; HR 11792). However, states are seeking direct funds as well.

14.6.2 Housing Types and Construction[1]

A more specific analysis of housing questions requires examination of the type of housing supplied (i.e., single-family or multi-family units) and of the type of construction technique (i.e., stick, modular, or mobile home units). Decisions on ways to meet local housing needs must take these alternatives into account.

In the past 20 years, an important national trend in housing has been a shift from single-family to multi-family units. For example, multi-family units have increased their share of all new housing units from 22 percent in 1960 to 45 percent in 1970.[2] Several factors have led to this growth. First, the changing age distribution of the population has resulted in the formation of new families that are typically renters rather than home buyers. Second, apartment rental rates have risen much less in recent years than the cost of home ownership, because the latter reflect substantial increases in land and construction costs. Finally, lending considerations have encouraged some lenders to undertake apartment construction. Many lenders are much more willing to finance multi-family units if they can share in the profits through "kicker clauses".

The nature of the housing construction industry largely determines its response to demand. It is generally an industry of small operators tied to local markets where construction decisions must be made months in advance.[3] The local characteristics of the housing market, building codes, zoning ordinances, local labor market, and union work rules all serve to reinforce the localization of the industry. Perhaps even more important, mortgage financing is restricted to the lending bank's marketing area, the area for which lending information is available. Because of the difficulties in moving from one market to another, even the largest builders tend to build in only a few market areas.

Three alternative construction techniques for housing are conventional stick-built, modular construction, and mobile home construction. Conventional or "stick-built" housing involves on-site construction by skilled craftsmen and laborers. Building materials are brought to the site and assembled.

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[1] This section draws heavily from a paper prepared by Arn Henderson and Daniel B. Kohlhepp for the Science and Public Policy Program. Henderson is in the School of Architecture and Kohlhepp in the College of Business Administration at the University of Oklahoma.

[2] U.S., Department of Commerce, Construction Review, Vol. 18 (April 1972), p. 17.

[3] As recently as 1972, 50 percent of the single-family homes in America were built by firms with a total annual volume of less than 75 units.

Mobile homes and modular units are both constructed using assembly line techniques. Basically, modular housing consists of a number of self-contained house sections that are mass-produced in a plant. Even plumbing and wiring are installed at the "factory". The modules are transported to a site where a crane is usually needed to lift the modules from a truck onto a concrete slab or foundation. The sections are then attached and the wiring and plumbing connected, using on-site labor.

The mobile home is factory built on a rigid platform attached to several pairs of tandem wheels equipped with pneumatic tires. Wood-stud walls, which are usually used, are sheeted with aluminum siding and entirely pre-finished on the interior. Mobile homes are most often sold as furnished units and include major appliances, such as range and refrigerator. A unit is towed to the site, leveled, and connected to utilities. The size of both mobile homes and modular units is limited by state highway regulations. The maximum allowable width for transporting either type is 14 feet or, in a few states, only 12 feet.[1]

Public approvals required for planned housing tend to favor conventional construction methods and single-family homes. In particular, zoning ordinances limit or prohibit multi-family and mobile home units in some areas, primarily on the basis of density. Building codes are generally geared toward conventional stick construction of either single- or multi-family units, and it is often difficult for modular and mobile homes to meet these code requirements. These considerations apply in all eight western states in this study.

Labor requirements, materials, and construction time for the three types of construction also vary. Whereas conventional housing requires a local pool of skilled laborers, modular and mobile homes do not because of factory assembly. Mobile homes frequently use cheaper, lighter-weight materials than either conventional or modular housing. In fact, modular homes will usually require a great amount of reinforcement material to withstand structural stresses in loading, transportation, and unloading.

Finally, the construction time of the three methods appears to greatly influence the choice among housing types. Clearly, factory-produced homes can be built much faster than conventional housing, where bad weather, late deliveries of materials, and problems with subcontractors cause delays. A modular home can usually be built, delivered, and set up within 30 days from receipt of order.[1] However, delivery time and costs prohibit delivery of modular and mobile homes beyond about 300 miles. In response to this, mobile home manufacturing has become quite dispersed throughout the nation, allowing short delivery times even in isolated western areas. The large capital investment required for modular home construction effectively restricts it to high-density urban markets, making it a less attractive alternative in the West.[2]

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[1] Davidson, Harold A. Housing Demand: Mobile, Modular or Conventional? New York, N.Y.: Van Nostrand Reinhold, 1973, pp. 4-5.

14.6.3 Provision of Housing

A. Short-Term Housing

The choice of housing type and construction type ultimately is made by what is available and the possible source(s) of financing. More fundamentally, housing choices vary from construction to operation phase. There is little incentive for private developers to try to build permanent (conventional or modular) housing for a temporary construction boom. Some private sector and virtually all public sector financing requires a high likelihood of long-term occupancy to repay mortgage loans. The solution during construction, then, appears to be mobile homes.[3] Other arrangements, such as employee barracks, are usually much less satisfactory for the residents.[4]

However, unplanned mobile home parks and subdivisions create major difficulties for local and county governments, especially with regard to their ability to control land use, regulate activities, and provide service. Once existing spaces in developed mobile home parks have all been taken, newcomers will tend to scatter on any available land. Sites outside municipal limits may lack adequate electricity, water, sewer, and telephone service. Provision of public services may be a problem, even within city limits, if population growth is too rapid.

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[1] Kreis, Robert. "A Challenge to Efficiency," in Modules and Mobiles Conference Proceedings. Anaheim, Calif., February 1970, p. 69.

[2] Biderman, Charles. "Blueprint for Disaster." Barron's, Vol. 52 (July 3, 1972), p. 12.

[3] As a result, 53 percent of construction workers at five surveyed communities in the West were living in mobile homes. Mountain West Research. Construction Worker Profile, Final Report. Washington, D.C.: Old West Regional Commission, 1976, p. 103.

[4] Denver Post, November 1 and 24, 1976.

At that time, the mobile homes must be removed; the developer intends to build permanent housing.[1]

Although mobile homes may be the only way to provide enough temporary housing, they may also contribute to worker (or spouse) dissatisfaction with housing and, ultimately, to high labor turnover and lower productivity.[2] Moreover, the social environment of many projects is directly related to existing state statutes and the degree of enforcement.[3] One means of improving conditions, especially of unplanned mobile home parks, would be the improvement of state mobile home park codes and design standards, and state and local subdivision regulations. Currently, only Montana and North Dakota have guidelines for mobile home park design, and only Montana has a mobile park code that is enforced at the local level by a representative of the state government.[4]

Federal actions on housing appropriate for construction periods are rather limited.[5] Model mobile home ordinances can be financed under the Department of Housing and Urban Development's (HUD) 701 Planning Program. The Federal Housing Administration within HUD has developed planning and construction criteria for mobile home projects.[6] The more common federal housing programs for elderly and low-income families appear to be suitable in many communities, where competition for housing among construction workers has resulted in inflation in local housing markets and displacement of families.[7]

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[1] U.S., Department of Housing and Urban Development, Office of Community Planning and Development. *Rapid Growth from Energy Projects: Ideas for State and Local Action, A Program Guide.* Washington, D.C.: Government Printing Office, 1976, p. 22.

[2] Jacobsen, L.G. "Coping with Growth in the Modern Boom Town." *Personnel Journal*, Vol. 55 (June 1976), pp. 288-89, 303.

[3] Rapp, Donald A. *Western Boomtowns*, Part I, Amended: *A Comparative Analysis of State Actions.* Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, p. 19.

[4] *Ibid.*

[5] Refer to Section 14.5 for an elaboration of federal assistance programs.

[6] HUD. *Rapid Growth from Energy Projects*, pp. 19-23.

[7] Rapp. *Western Boomtowns*, p. 20.

B. Long-Term Housing

The housing situation for long-term workers is not easy to separate from short-term shortages when several energy developments are getting underway in a community at the same time. In an unplanned case where different energy developers are involved, employees from both developments compete for the same housing. In this case, even long-term workers and their families often must live in mobile homes, especially when very little new permanent housing is being built. Considerable social distance can separate those fortunate enough to live in permanent homes and those in mobile homes on the edges of towns.[1]

Planned, landscaped mobile home parks help to reduce the worst conditions, but permanent single-family homes are by far the type preferred by most workers.[2] The housing mix at Colstrip was intended to meet most of these demands. However, an over-planned situation can lead to claims of residential segregation on the basis of employment status.[3] Also, fully planned company towns are quite expensive and are generally unlikely in the West.[4]

The market for housing financing is a major contributor to the lack of permanent housing. High down payments and monthly costs can prohibit even fairly well-paid employees from buying modular or conventional homes. Local inflation and salary levels often effectively preclude the possibility of federal programs intended for low- and middle-income housing.[1] As a result, local builders are reluctant to build housing at current prices, even where local lenders are willing to finance home mortgages. Lending institutions do not have an incentive to promote permanent housing since mobile homes are financed on consumer loans at much higher rates of interest than mortgage loans. Further, local lending institutions would have greater lending capacity if major companies could be persuaded to deposit more of their capital in western rather than in eastern financial centers.[2]

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[1] Federal Interagency Team. The Energy Boom in Southwest Wyoming. Washington, D.C.: U.S., Department of Housing and Urban Development, 1976, pp. 3-4.

[2] Gilmore, J.S., and M.K. Duff. Boom Town Growth Management. Boulder, Colo.: Westview Press, 1975, pp. 133-144; Jacobson, L.G. "Coping with Growth in the Modern Boom Town." Personnel Journal, Vol. 55 (June 1976), pp. 288-89, 303; Mountain West Research. Construction Worker Profile, Final Report. Washington, D.C.: Old West Regional Commission, 1976, p. 103.

[3] University of Montana, Institute for Social Science Research. A Comparative Case Study of the Impact of Coal Development on the Way of Life of People in the Coal Areas of Eastern Montana and Northeastern Wyoming. Missoula, Mont.: University of Montana, Institute for Social Science Research, 1974, pp. 16-18.

[4] Arthur Young and Company. Problems of Financing Services and Facilities in Communities Impacted by Energy Resource Development. Washington, D.C.: Arthur Young and Company, 1976.

Partially in response to these problems, most of the western states have created separate housing finance agencies or corporations to administer bonds and other fiscal tools to assist in housing development in sparsely populated areas.[3] Only Colorado has exercised the housing financing options to generate money to be passed through normal lending institutions in rural areas. Limits on the amount of bonds that can be sold range from $30 million in New Mexico to $75 million in Montana, $100 million in Wyoming, and $200 million in Colorado. Utah has no dollar limit on its bond sales. However, all the states except Colorado are awaiting legal review before implementing their programs.[4]

The least common housing alternative, modular construction, has only begun to receive adequate consideration as a solution to housing needs. "Operation Breakthrough", a HUD program established in 1969, was designed to modernize the housing industry by facilitating volume production of quality housing for people of all incomes.[5] Before this program was initiated, a major

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[1] Federal Interagency Team. *The Energy Boom in Southwest Wyoming*. Washington, D.C.: U.S., Department of Housing and Urban Development, 1976, pp. 3-9; Rapp, Donald A. *Western Boomtowns*, Part I, Amended: *A Comparative Analysis of State Actions*, Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, p. 20.

[2] Rapp, Donald A. *Western Boomtowns*, Part I, Amended: *A Comparative Analysis of State Actions*, Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, p. 20.

[3] Arizona and North Dakota are the exceptions, but the state-owned Bank of North Dakota can act readily in such areas without a separate entity.

[4] Rapp. *Western Boomtowns*, p. 19.

[5] U.S., Department of Housing and Urban Development. "Operation Breakthrough." *HUD Challenge*, Vol. 6 (June 1972), entire issue, p. 4.

Planned mobile home areas within town limits can alleviate some of the above problems, if only by public approval of their development. Utilities and other services are provided as part of the development, and community planning, zoning, and subdivision regulations can be expected to be followed. However, a no-growth attitude on the part of a community can easily result in the unplanned scatter of mobile homes now common in many western towns.

Housing projects financed and planned by energy developers are becoming a common alternative to unplanned and often scattered mobile homes. Although most such projects include permanent housing for long-term workers, provision of equipped mobile home spaces for construction workers are the short-term action. For example, Western Energy Company, the coal mining subsidiary of Montana Power Company, has built three residential areas to house employees in the company town of Colstrip. In addition to modernizing 62 older homes in the town, 226 single-family homes and 60 multi-family units have been built. More than 160 permanent mobile home spaces have been provided, along with a temporary trailer court primarily for construction workers. A commercial district, bike paths, and other amenities are also part of the "modern company town" plan.[1]

Company ownership of a town eases the problems of land-use planning and development timing. However, most company housing projects are not as all-inclusive and tend to include only mobile home spaces and planned street patterns. Atlantic Richfield's housing at the site of Wright, Wyoming is a less comprehensive example of housing provision for coal miners and their families. Other temporary mobile home parks provided by industry include a site near Page, Arizona for construction workers for the Navajo Generating Station. The land was leased from the Bureau of Reclamation on a 5-year, no-extension lease, after which period the park must be closed and the area returned to its natural state. Finally, the city of Green River, Wyoming is permitting Upland Industries to provide two mobile home spaces on each of 250 lots of a permanent subdivision for a maximum of 3 years.

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[1] Myhra, David. "Colstrip, Montana--the Modern Company Town," Coal Age, Vol. 80 (May 1975), pp. 54-57; Schmechel, W.P. "Developments at Western Energy Company's Rosebud Mine," W.F. Clark, ed. Proceedings of the Fort Union Coal Field Symposium, Vol. 1. Billings, Mont.: Eastern Montana College, Montana Academy of Sciences, 1975, pp. 60-66. University of Montana, Institute for Social Science Research. Comparative Case Study of the Impact of Coal Development on the Way of Life of People in the Coal Areas of Eastern Montana and Northeastern Wyoming. Missoula, Mont.: University of Montana, Institute for Social Science Research, 1974, p. 16.

drawback for modular housing was the proliferation of restrictive building and zoning codes. Although most states have passed industrialized housing laws and state building codes, differences among the state codes still cause problems for housing producers.[1]

Experience with modular housing in western towns has been mixed. In one case, three companies jointly loaned front-end development money to a small manufacturer of modular houses. This loan enabled the developer to construct a small subdivision of quality single-family houses that were readily accepted and, thus, enabled the builder to repay the loan with interest.[2] In the same area of southwest Wyoming, the selling price for some modular houses prohibits widespread acceptance by otherwise willing home buyers.[3]

14.6.4 Summary of the Special Problems in Housing

The causes of housing shortages in boomtown situations have received a great deal of attention. Less common is a consideration of the decisions involved in the choice of the type of housing and the type of construction. Mobile homes, a logical response to temporary housing needs, can become a more attractive answer if state and local regulations can control and enforce mobile home park codes, design standards, and subdivision design and operation. Permanent housing options suffer primarily from financial constraints that state housing authorities may be able to loosen in the near future. Federal housing programs devised specifically for energy-impacted communities in the West could eliminate the restrictions of current income-based programs. Industry's role in housing provision can either be indirect through loan guarantees or direct through actual development of subdivisions in rural areas.

14.7 COMMUNITY FACILITIES AND SERVICES

14.7.1 Introduction

The public sector in energy-impacted communities faces two substantial difficulties in providing adequate facilities and services. The first is that workers, their families, and others attracted by the development often move into an area before facilities and services have been expanded to meet new demands. The second is that revenues for the first several years of an energy project seldom balance expenditure needs.[1] Consequently, energy-impacted communities can be hard pressed to provide water and sewer systems, health care, schools, streets, public safety services, and recreation. This section discusses each of these potential problem areas and identifies some alternative responses for coping with them. Although these discussions mention the role of federal assistance programs available for these services and facilities, a fuller identification and discussion can be found in Section 14.5 (Growth Management).

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[1] Bureau of National Affairs. "Operation Breakthrough and Manufactured Housing: A Special HDR Status Report." *Housing and Development Reporter* (1973).

[2] Jacobson, L.G. "Coping with Growth in the Modern Boom Town." *Personnel Journal*, Vol. 55 (June 1976), pp. 288-89, 303.

[3] Federal Interagency Team. *The Energy Boom in Southwest Wyoming*. Washington, D.C.: U.S., Department of Housing and Urban Development, 1976, pp. 3-4.

14.7.2 Water and Sewer Systems

Rapid but often unstable population increases usually associated with energy development can cause substantial problems for community water and sewer systems. In part, these problems depend on the adequacy of existing services, in terms of both their capacity to serve all the new residents and their ability to cope with water quality problems. While the capacities of some communities will be adequate to deal with increased demands, many systems will quickly become overloaded, which may also affect other local problems such as housing and health.

A. Service Needs

Nearly all energy-impacted communities can anticipate a need for increased water supplies. As shown in our six site-specific scenarios, towns experiencing the largest population increases are likely to require 1-3 thousand additional acre-feet of water per year (acre-ft/yr) by 1980 and 4-9 thousand additional acre-ft/yr by 2000.[2]

Service needs are also likely to arise for sewage systems and water treatment facilities. In some communities, designed capacities are already exceeded, and many others do not have the excess capacity to handle the expected influx of new residents. This was a consistent finding of the impact analyses reported in

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[1] Documentation and elaboration of these impacts can be found in the Social, Economic, and Political Impacts sections of Chapters 6-11.

[2] These ranges reflect projected needs for Escalante, Farmington, Gillette, and Bismark-Mandon. Refer to Chapters 6, 7, 9, and 11, respectively.

Chapters 6-11. Nearly all urban areas experiencing large population increases are expected to require new waste treatment facilities by 1980.[1]

These communities' problems are compounded by the Federal Water Pollution Control Act Amendments (FWPCA) of 1972.[2] This law requires that existing public treatment works install secondary waste treatment by 1977 and "best practicable" waste treatment technologies by 1983.[3] The best practicable techniques by 1983 requirement also applies to new public waste treatment works. In addition, the goal of the FWPCA is to prevent the discharge of pollutants into local streams after 1985.

Based on existing conditions in those areas where energy development is hypothesized, the 1977 deadline for secondary treatment in public works will probably not be met. However, several studies suggest this violation will be a national phenomena owing to overly complicated administrative procedures and to long delays in processing grant applications.[4] In addition, current trends in grants for municipal sewage systems suggest that the original $18 billion authorized by the FWPCA will be spent by September 1977.[5] Thus, growth in urban areas impacted by energy development will come at a time when funding uncertainties appear to be great.[6]

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[1] Existing treatment practices for major communities in the scenarios is discussed in the water effluents sections of Chapters 6-11.

[2] Federal Water Pollution Control Act Amendments of 1972, 86 Stat. 816, 33 U.S.C.A. §§ 1251 *et seq.* (Supp. 1976).

[3] For a discussion of the FWPCA's requirements for private works and for energy facilities, refer to Section 14.2.

[4] Studies were conducted by EPA, the National Commission on Water Quality, and National Utility Contractors Association, as reported in U.S., Council on Environmental Quality. *Environmental Quality*, Sixth Annual Report. Washington, D.C.: Government Printing Office, 1975, pp. 71-72.

[5] U.S., Environmental Protection Agency. *Review of the Municipal Waste Water Treatment Works Program*. Washington, D.C.: Government Printing Office, 1974, p. 54.

[6] Other particularly significant issues for the western states concern the use of federal funds to build excess capacity in anticipation of population growth and additional legislative requirements to ensure against negative direct or secondary environmental impacts as a result of wastewater treatment facility construction or expansion.

Existing treatment problems may be exacerbated by urban runoff as population and the amount of total paved area increases. As the impact analyses reported in Part II suggest, untreated storm water runoff may contact effluents or inorganic materials not previously present in the waters in large amounts. In many cases, these contaminants could possibly go directly into water systems.

Financial constraints often complicate community problems, especially when septic tank systems cannot be used. This is often the case in areas with highly permeable soil.[1] Secondary treatment is a poor alternative to septic tanks for most energy-impacted communities because the costs for serving a few thousand people may total millions of dollars. Further, many western communities face large but temporary population increases. In these situations, the high capital costs of sewer and water treatment systems can seldom be amortized within short demand periods. Hence, the only feasible choice for some communities is to allow short-term violations of water pollution regulations and/or health standards. Moreover, it is not uncommon for western state governments to lack the funds and personnel required to enforce standards and regulations, especially in rural areas.[2]

The lack of sufficient water and sewer systems affects other local problems and issues. Unless septic tanks or individual wells can be used, new housing must often be delayed until new sewers or water mains are built.[3] Likewise, mobile home subdivisions that depend on septic tanks encourage scattered development on the fringe of established towns. Therefore, the population is dispersed into small groups, often creating land-use and public service problems that are even more difficult to control than those associated with water and sewer systems.

B. Responses

Assistance for planning and constructing water and sewer systems comes almost entirely from federal programs. The largest single source is Section 208 of the FWPCA which created a planning and management program for areawide wastewater treatment incorporating local communities, states, and the Environmental Protection Agency (EPA) regional agency.[1] Several western regions have received EPA 208 planning grants such as the Colorado West Council of Governments for the area impacted by oil shale development, the Five County Association of Governments in Southwest Utah, and the Powder River Area of Wyoming, including Campbell County.[2]

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[1] As reported in Chapter 9, septic tanks are probably not a viable option for the Gillette area because of the expansive clay soil.

[2] Rapp, Donald A. Western Boomtowns, Part I, Amended: *A Comparative Analysis of State Actions*. Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976.

[3] One problem is a lack of knowledge about the existing system; for example, maps which show where it goes. This proved to be a problem in Gillette, Wyoming when the city was planning an expansion of its water system.

Assistance on water and sewage problems can also be obtained from other sources.[3] Green River, Wyoming has allowed the developer of a 640-acre project to put in a package sewer treatment plant until the city's new plant is completed under present EPA funding. At the time the city plant is completed, the sewer line of the subdevelopment is to be connected. In this case, the cost is being carried entirely by the developer.[4] Grants from federal regional commissions are also an alternative. Because of its special problems, Appalachia has been singled out for a combined federal-state-local effort to improve economic and social conditions. The Appalachia Regional Commission has put additional aid on top of the basic federal assistance through the Appalachian Regional Development Act. Supplementary grants for basic water and sewer facility construction increase the federal contribution to 80 percent of costs, rather than the usual 75 percent.[5] Although they do not now have such assistance programs, the Four Corners and Old West Regional Commissions have the structure for handling such supplemental aid.

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[1] Federal assistance for water and sewer systems is discussed in more detail in Section 14.5.5.

[2] As noted in Section 14.2, Indian tribes can participate in the 208 program.

[3] For a comprehensive listing of these programs, see Table 14-6.

[4] U.S., Department of Housing and Urban Development, Office of Community Planning and Development. Rapid Growth from Energy Projects: Ideas for State and Local Action, A Program Guide. Washington, D.C.: Government Printing Office, 1976, p. 28.

[5] Berlin, Harriet G. "Federal Aids for Pollution Control," in Bureau of National Affairs. Environment Reporter, Monograph No. 4 (October 1973), p. 28.

14.7.3 Health Care

A. Service Needs

As is the case with most social services, additional stress will be placed on community health services and delivery systems by energy development. In addition to increased service needs, specialized medical services will be required to deal with particular types of injuries associated with energy industries.[1] Also, the demand for mental health services will grow accordingly. Caseloads have increased more than four times as fast as the population in previous boomtown situations.[2]

Western boomtowns characteristically face increased service demands with inadequate supplies of doctors. As reported in Chapter 9, only eight doctors (a ratio of one doctor per 900 residents) served Gillette, Wyoming in 1974. By comparison, Sheridan, Wyoming has 17 doctors, a ratio of one per 675 people, which is close to the national average. Because of the inadequate supply in Sweetwater County, Wyoming, approximately 40 percent of the county residents must travel elsewhere to receive health services. Indeed, people who live in areas where development is already under way commonly travel to larger neighboring communities for medical services.[3] Moreover, small towns often face considerable difficulties in recruiting physicians or allied health professionals (such as nurses and hospital staff) because of remote locations and wage competition from urban areas.

B. Responses

Energy-impacted communities may look to both the state and federal government for assistance in providing health care services. Most of the western states have Public Health Nursing services and health planning agencies.[1] States also may make use of programs provided by the Western Interstate Commission on Higher Education such as training in premedical school, public health, mental health, nursing, and health research interns. Many states provide funds for: alcohol, drug abuse, and mental health programs; licensed practical nurse training; and family practice residency training to encourage doctors to locate in rural areas.

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[1] Real Estate Research Corporation. *Excess Cost Burden, Problems and Future Development in Three Energy Impacted Communities of the West*, for U.S., Dept. of the Interior, Office of Minerals Policy Development. 1975, p. IV-1.

[2] This was the case in Rock Springs, Wyoming. See: Rapp, Donald A. *Western Boomtowns*, Part I, Amended: *A Comparative Analysis of State Actions*, Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976.

[3] Mountain Plains Federal Regional Council, Socioeconomic Impacts of Natural Resource Development Committee. *Socioeconomic Impacts and Federal Assistance in Energy Development Impacted Communities in Federal Region VIII*. Denver, Colo.: Mountain Plains Federal Regional Council, 1975, p. 5.

Alternative ways of providing health personnel and physicians have surfaced in energy-impacted areas. The Wyoming Human Services Project is a good example (see Chapter 9). This program trains students in their last year of coursework at the University of Wyoming to work in multidisciplinary teams in Wyoming communities for 1 year after graduation. After this service, some of the participants find positions in such fields as mental health, public health services, and public administration. The training part of the program is supported by a 5-year, $470-thousand grant from the National Institute of Mental Health. Gillette is presently taking advantage of the program.

Although recruiting physicians is more difficult, the Southwest Wyoming Industrial Association (SWIA) is helping both Green River and Rock Springs with this problem. SWIA guaranteed a $75-thousand loan to Green River to establish an interest in private practice and to bring in two general practitioners being provided by the National Health Service Corps (NHSC). A grant has been given to the Wyoming Health Maintenance Organization (HMO) for recruiting physicians to Rock Springs, and a loan guarantee is providing a modular clinic and front-end money for the HMO.[2]

Federal assistance programs have played a significant role in shaping state responses to health service needs.[3] For example, federal assistance helps the Wyoming HMO to offer prepaid health care (a set monthly fee provides every medical service required) and a preventive medicine program that will pay physicians' fees without requiring hospitalization. Where not prohibited by labor union provisions, HMO's could be offered by energy companies as an alternative form of health insurance for employees and their families. The Health Services Administration of the Department of Health, Education and Welfare (HEW) can give project grants, research contracts, direct loans, and guaranteed loans to organizations that plan to set up an HMO.

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[1] According to the National Health Planning and Resources Development Act of 1974, 88 Stat. 2225, 42 U.S.C.A. §§ 300k *et seq.* (Supp. 1976), federal programs to develop and implement comprehensive health planning services at the state level are being phased out and will be replaced by new policies and programs that encourage private corporations to function as substate "Health Service Agencies".

[2] U.S., Department of Housing and Urban Development, Office of Community Planning and Development, *Rapid Growth from Energy Projects: Ideas for State and Local Action, A Program Guide*, Washington, D.C.: Government Printing Office, 1976, pp. 25-27.

[3] For a more comprehensive discussion of federal assistance, refer to Section 14.5.5.

Another potential aid is the National Health Service Corps, which is designed to improve the delivery of health care services in areas critically short of health personnel. The Secretary of HEW may assign personnel to designated communities, especially for the purposes of primary medical or dental care. The number and type of persons assigned and the duration of their stay depends primarily on the nature of existing shortages.

14.7.4 Schools

A. Service Needs

In contrast to the situation for most other service categories, the demand for schools may be greater during the operation phase than during construction phase of an energy development because construction workers are less likely to bring their dependents with them.[1] However, plans to meet school enrollment increases must deal with a number of uncertainties. For example, the extent to which a school system becomes inadequate will depend largely on the rate at which workers relocate their families. Second, schools in communities near an energy project have commonly experienced enrollment spurts, usually concentrated in a few grade levels.[2] Thus, school districts will have difficulty in predicting both the number and grade levels of incoming children. Third, in many cases, energy facilities are developed near several communities; for instance, employees at the Colstrip project may live in Colstrip, Lame Deer, Hardin, Forsyth, or even in Billings, which is 80 miles away. These options complicate the problem of projecting service needs for any one school district.

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[1] This phenomenon is documented in our site-specific scenarios, Chapters 6-11. For example, in Colstrip enrollments are projected to increase less than 50 percent by 1983. However, between 1983 and 1993, both elementary and secondary enrollments are projected to double.

[2] Battelle Memorial Institute, Pacific Northwest Division, Human Affairs Research Centers. *Identification and Management of Economic and Social Impacts of Nuclear Energy Centers: A Preliminary Analysis*, Final Report, for U.S., Nuclear Regulatory Commission, Richland, Wash.: Battelle Pacific Northwest Laboratories, 1975, p. 68.

Schooling usually represents the largest single expense faced by local governments. Indeed, schools may account for 40 percent of per-capita expenditures, regardless of whether the population is increasing, stable, or declining.[1] The burden of these expenditures on communities is even greater where temporary increases in school size are financed by issuing long-term municipal bonds. Unless some mechanism other than typical tax programs is used to pay for school expansion, school taxes will often have to increase to cover capital and operating expenditures, at least until the energy project is in its operational phase and on the local tax rolls.

There are exceptions to this trend. The findings from our site scenarios (Chapter 6-11) suggest that school districts may benefit more from energy-related revenues than do local governments. In situations where school-age populations do not begin rapid expansion until the operation phase, school districts may have revenue surpluses. For example, in Rosebud County, Montana, school districts are expected to enjoy substantial surpluses if current tax rates are maintained.[2]

B. Responses

The study-area states can respond to the potential problems of providing adequate schools in several ways.[3] Many western states have an Education Foundation Program which administers state aid to public schools. In almost all cases, these programs use funds from mineral royalties provided by the National Mineral Lands Leasing Act.[4] In addition, North Dakota and Montana have designated a percentage of their coal severance taxes (30 and 10 percent, respectively) to a perpetual trust fund for their state's education program.

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[1] Kutak, Rock, Cohen, Campbell, Garfinkle & Woodward. A Legal Study Relating to Coal Development--Population Issues, Vol. I: Responding to Rapid Population Growth, for the Old West Regional Commission. Omaha, Neb.: Kutak, Rock, Cohen, Campbell, Garfinkle & Woodward, 1974, pp. 77-78.

[2] Refer to Chapter 10.4.6.

[3] Examples and discussion of state programs rely heavily on Rapp, Donald A. Western Boomtowns, Part I, Amended: A Comparative Analysis of State Actions, Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, pp. 33-39.

[4] Under National Mineral Lands Leasing Act of 1920, as amended, 41 Stat. 437, 30 U.S.C.A. §§ 184 et seq. (1971), a state receives 37.5 percent of bid, rental, and royalty income to be used for public school and highway expenses.

In 1974, the New Mexico State Legislature devised a means of financing public elementary and secondary schools through a broad-based equalization plan and comprehensive weighting system. The new law has been cited by the Education Commission of the U.S. as one of the most innovative in the U.S. In particular, proponents of the equalization plan believe that it provides a way of responding in a timely manner to school impacts caused by energy development.

Colorado provides grants from oil shale lease monies for emergency classrooms, capital construction programs, and other facility needs in impacted communities as a line item authorized by the Legislature. Wyoming makes available impact grants[1] from its coal tax revenue account (administered by the Farm Loan Board), and Utah's Resource Development Act of 1975[2] (which allows the prepayment of taxes) provides for funds that can be loaned by the State Board of Education.

However, all these states need a bonding authority to provide funds for school construction. In the past year, Wyoming has implemented such a program through its Community Development Authority, and North Dakota has provided a bond service to school districts through the Bank of North Dakota.

Until adequate state and federal assistance programs are in place, communities may need help from energy companies, such as grants or loans, to provide for their public school system.[3] For example, in Colstrip, Montana, the Western Energy Company has responded to school needs by loaning buildings, temporary classroom structures, and other space. The company has also provided, at no cost, land for a new building and for the construction and maintenance of a football field.

14.7.5 Streets

A. Service Needs

Rising street maintenance costs and traffic control are the most immediate transportation-related problems faced by energy-impacted communities.[1] Traffic control problems are largely those of intersection control and the need for more local police, police cars, and communication equipment to restrain violators. As the population becomes more permanent, local and regional transportation components, such as taxi service, bus, rail, or air systems, may also need expansion. However, these needs are often beyond the capacity of the local government because they are usually very costly, their funding system is located outside of local jurisdiction, and state and federal aid may be insufficient to help in financing improvements.[2]

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[1] Wyoming Statutes §§ 31.1-245, 21.1-250 (Cumulative Supplement 1975).

[2] Utah Code Annotated § 63-51-6 (Cumulative Supplement 1975).

[3] At present, the concept of federally impacted school districts does not include districts in primary energy development areas. Some grants are available from the normal programs of the Office of Education of the Department of Health, Education and Welfare.

More specific to coal towns are problems created by coal-carrying unit trains that may block railway crossings.[3] Waiting periods for crossings may become as much as 20-45 minutes. If the road in question is a state responsibility, the problem can be alleviated if enough pressure is brought to bear on the state to build an overpass. However, if it is a local road and the railroad will not assume responsibility, most small local governments lack the funds to construct and maintain an overpass.

B. Responses

An alternative to automobile traffic for energy facility workers is to run shuttle buses from the facility to the nearby town or towns. However, to be economical for the employee, this response would probably require the proprietor of the facility to subsidize a substantial portion of the costs.[4]

Funding for improvements to highways serving major employment centers could come from the state highway fund, the energy company, and local street funds.[1] Some counties are using their limited revenue sharing money to upgrade their highways.[2] At least 60 percent of the revenues derived from Wyoming's coal tax are earmarked for local or state roads. In addition, the money can be used to match federal grants and can be used to support borrowed funds.[3] Similarly, Utah's Resource Development Act[4] allows energy companies to prepay their taxes. The State Road Commission may then spend its money on state highways in the energy development area or can make special grants to the county for county improvements.

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[1] These problems affect streets in two major places: the roads to the energy project from the neighboring communities (which may involve both state and county roads) and streets within the localities themselves.

[2] Real Estate Research Corporation. *Excess Cost Burden, Problems and Future Development in Three Energy Impacted Communities of the West*, for U.S., Dept. of the Interior, Office of Minerals Policy Development. 1975, p. VI-3.

[3] See Chapter 12 for a more detailed discussion of this problem.

[4] A model for this system exists for the National Reactor Testing Station in Idaho. Over 100 buses are used to commute employees to and from work to nearby cities such as Idaho Falls and Pocatello.

14.7.6 Public Safety

A. Service Needs

Rapid population growth is usually accompanied by an increase in area crime.[5] Although the seriousness of increased crime appears to be related to many geographical and social factors, most energy-impacted communities will face increased service demands associated with real or perceived threats to community safety.[6]

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[1] Refer to Section 14.5 for a listing of traditional federal funding programs available for road maintenance and improvement.

[2] Twomey, James P., and Peter G. Kuh. *Governmental Programs, Resources and Regulatory Powers Available to Assist Localities During Coal Development*. Denver, Colo.: Northern Great Plains Resources Program, 1974, p. 15.

[3] U.S., Department of Housing and Urban Development, Office of Community Planning and Development. *Rapid Growth from Energy Projects: Ideas for State and Local Action, A Program Guide.* Washington, D.C.: Government Printing Office, 1976, p. 32.

[4] Utah Code Annotated § 63-51-3 (Cumulative Supplement 1975).

[5] Gilmore and Duff have argued that serious crime increases can be expected with growth rates above 5 percent. See Gilmore, J.S., and M.K. Duff. *Boom Town Growth Management*. Boulder, Colo.: Westview Press, 1975.

[6] Perceived threats create demands for additional protective services just as real threats do. Thus, the expectation of substantial development-related increases in area crime by many residents will have significant impacts on the public safety budgets of small communities. As an example of the extent of these perceived threats, 70 percent of the residents of Carbon and Emery Counties (Utah) expected an increase in crime and drug use with new coal development. See Albrecht, Stan L. *The Impacts Associated with Energy Development in Carbon and Emery Counties, Utah.* Provo, Utah: Brigham Young University, 1975.

For example, Rosebud County, Montana experienced a 547-percent increase in total felony and misdemeanor arrests between 1972 and 1973.[1] Delinquency and alcoholism are among the most common problems.[2] In Farmington, New Mexico, approximately 80 percent of reported minor crimes in 1975 were related to alcoholism, particularly juveniles driving while intoxicated. Juvenile delinquency is regarded as the leading law enforcement problem in San Juan County, New Mexico where juveniles accounted for about 30 percent of all major and minor crimes in 1972-73.[3]

If similar crime increases occur in energy-impacted communities, most existing service systems will probably be incapable of meeting the community needs. Improvements will probably be required in facilities (especially jails), equipment (especially communications and information storage/retrieval capabilities), and staff size and training. Another problem may be the adaptation of long-term police officers to the rapidly changing circumstances. Where such officers have become accustomed to a peaceful community, rural crime patterns, and informal relations with personal acquaintances, they may have problems in dealing with newcomers who commit urban-type crimes or demand urban-type police behavior.[4]

Public safety service needs also include fire protection. Because most small, rural communities have volunteer fire departments, they may be especially hard-pressed to provide adequate services. Even in cases which personnel are paid for this work, higher rates associated with energy-related jobs may attract persons away from their service employment. Further, dispersed housing and scattered mobile home locations present volunteer fire departments special problems of response time; these problems are even more critical in very remote areas where water availability or pressure may not be adequate.

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[1] Felonies increased from 7 to 13. Misdemeanors increased from 122 to 835. See: Montana Energy Advisory Council. *Coal Development Information Packet*, Supplement I. Helena, Mont.: State of Montana, Office of the Lieutenant Governor, 1975, p. 5.

[2] Kohrs, E.V. Paper presented at the meeting of the Rocky Mountain Division, American Association for the Advancement of Science, Laramie, Wyoming, July 24-26, 1974, as cited in Christiansen, Bill, and Theodore H. Clark, Jr. "A Western Perspective on Energy: A Plea for Rational Energy Planning." *Science*, Vol. 194 (November 5, 1976), p. 581.

[3] Data for San Juan County and Farmington from Real Estate Research Corporation. *Excess Cost Burden, Problems and Future Development in Three Energy Impacted Communities of the West*, for U.S., Dept. of the Interior, Office of Minerals Policy Development. 1975, p. VI-10.

[4] Twomey, James P., and Peter G. Kuh. *Governmental Programs, Resources and Regulatory Powers Available to Assist Localities During Coal Development*. Denver, Colo.: Northern Great Plains Resources Program, 1974, p. 15.

B. Responses

To begin to cope with these issues, rural communities can apply for Federal comprehensive law enforcement planning grants to finance jail construction and other facilities, and comprehensive service grants to improve their criminal justice systems. Federal assistance for acquisition and renovation of correctional institutions and the prevention of juvenile delinquency is available through formula grants from the Law Enforcement Assistance Administration and from discretionary funds. However, the emphasis of these programs has been to reduce crime in major cities and develop state criminal justice standards. Hence, competition is strong.[1]

Federal assistance programs to upgrade local fire prevention and delivery services are not as extensive as for other categories. Loans from the Farm Home Administration (FHA) may be used for fire systems or facilities that serve open country or communities of less than 10 thousand population. FHA also provides grants-in-aid for fire-fighting equipment of up to 50 percent of the cost. This program is explicitly directed toward volunteer fire departments in communities of less than two thousand. Under its Cooperative Forest Fire Control program, the U.S. Forest Service also provides financial and technical assistance grants to rural communities to operate and equip fire departments.

Many local, county, and state governments in the West have difficulty planning and implementing coordinated efforts to deal with law enforcement problems. To alleviate such problems, local authorities could "rent" the needed personnel and facilities, rather than purchase them, during construction phases when the extent of impacts are uncertain. For example, counties could contract with the state for additional law enforcement officers (e.g., highway patrol personnel) and could terminate the contract when conditions stabilize.[2]

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[1] U.S., Department of Housing and Urban Development, Office of Community Planning and Development, *Rapid Growth from Energy Projects: Ideas for State and Local Action, A Program Guide*. Washington, D.C.: Government Printing Office, 1976, p. 45.

[2] *Ibid*.

14.7.7 Recreation

A. Service Needs

Many residents of the western states consider the "great outdoors" to be sufficient for most recreational needs. However, newcomers to the region may prefer the kind of services generally provided in larger communities, such as city parks, golf courses, or recreation centers with swimming pools and tennis courts. Many small communities do not have such facilities and thus cannot meet even minimal recreation or leisure time demands in these areas. Also, these communities generally do not have programs for elderly persons or day-care services for working mothers. Since local communities will be facing many new demands for other facilities and services, permanent residents will probably be reluctant to support new taxes for such recreational facilities.[1]

Even if the necessity of communitywide recreation facilities is recognized, procuring the necessary space will still be a problem, especially where other demands are viewed as being more pressing. Consequently, lack of recreational programs can easily lead to increased pressures for other services (e.g., law and mental health) and can also interfere with local efforts to recruit and retain professionals.

B. Responses

Matching grants to state and local governments for acquisition and development of public outdoor recreation areas and facilities are provided by the Land and Water Conservation Fund.[2] Funds are granted to states on a project basis and may be transferred to counties or towns for approved projects. However, competition of this type for locally sponsored projects is very severe in most states. Additional federal assistance in the form of loans and grants, including relevant use restrictions and eligibility requirements, is discussed in Section 14.5.

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[1] As noted at the outset, permanent residents are more accustomed to using the "great outdoors" for recreational purposes, or since they have lived in a town for years without certain amenities related to urban lifestyles, they may not immediately see the need for them.

[2] Under the Land and Water Conservation Act of 1965, as amended, 78 Stat. 897, 16 U.S.C.A. §§ 460d, 460l-4 through 460l-11(1974), each state receives an annual apportionment based on statutory formula.

14.7.8 Summary

Almost all energy-impacted communities will experience rapid population growth which will affect their ability to provide essential public services and facilities. Water and sewer systems, health care services, schooling, street maintenance, public safety services, and recreational services will all need to be expanded. Of these, water and sewer systems will normally require the most immediate attention because they will be needed shortly after construction begins and they may have a direct impact on housing patterns and health problems. The need for most other services, especially health care, is also likely to be immediate. The one exception to this trend is probably school facilities, which frequently expand much more during operation than construction. Moreover, school systems often face less severe financial constraints than do other service categories.

Federal assistance is available to communities in each of the service areas. However, few federal grant or loan programs are explicitly directed towards small, predominantly rural towns which typically are hardest hit by energy development. Since competition is so keen for federal dollars and most small communities lack experience in applying for assistance, they usually will need other assistance to meet new service demands. Most western states have partially responded through such mechanisms as community development agencies, training programs, and tax funds earmarked to impacted communities. Further, some communities have received aid from developers. In spite of these forms of assistance, many impacted communities are likely to be unable to adequately respond to new demands for services and facilities at least during the first few years of an energy project.

14.8 INDIANS

14.8.1 Introduction

Indian lands currently produce significant amounts of energy resources, as shown by the fiscal year 1974 summary in Table 14-7. Further, most of those resources were produced in the eight-state study area: the coal was produced in Arizona, Montana, and New Mexico; the uranium was produced in New Mexico; and the oil and natural gas were produced in Arizona, California, Colorado, New Mexico, and Oklahoma.[1] Additionally, the 271 Indian reservations in the U.S. are estimated to contain up to

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[1] See Appendices A, B, and C; U.S., Federal Trade Commission, Bureau of Competition, Report to the Federal Trade Commission on Mineral Leasing on Indian Lands. Washington, D.C.: Federal Trade Commission, 1975. Arizona is listed for both uranium and oil and natural gas apparently because Window Rock, Arizona is the capital of the Navajo Reservation.

TABLE 14-7: ENERGY RESOURCE PRODUCTION ON INDIAN LANDS DURING FISCAL YEAR 1974

Resource	Production	% of All Public and Indian Lands	% Of Total U.S.
Coal	11,508,000 tons	36.3	1.9
Oil	30,685,000 bbl	15.4	1.0
Natural Gas	125,060,000 mcf	3.7	0.6
Uranium Ore	1,136,739 tons	100.0	19.0

bbl = barrel(s)
mcf = thousand cubic feet

Source: U.S., Federal Trade Commission, Bureau of Competition. Report to the Federal Trade Commission on Mineral Leasing on Indian Lands. Washington, D.C.: Federal Trade Commission, 1975, pp. B-21.

one-tenth of the nation's coal reserves, and one-sixth of all uranium recoverable at $8.00 per pound.[1] Most of these resources are contained on a few of the approximately fifty Indian reservations located in the eight states included in this study.[2]

The energy resources possessed by Indians create several problems and opportunities which warrant special attention. A pervasive issue is the status of Indian lands. By giving up their status as sovereign nations and entering into a trust relationship with the federal government, Indians assumed a unique position in the federal system; that is, they are immune from state and local controls not expressly granted by the Congress. Despite the apparent simplicity and clarity of this principle, considerable ambiguity exists concerning the jurisdiction of states in the implementation and enforcement of some federal environmental legislation. The same situation exists with regard to Indian water rights which will be affected by and will affect energy development within the eight-state study area. These ambiguities and others discussed below are affected by the changing relationship between Indians and the federal government. Problems and issues in energy resource development, which arise because of the status of Indian lands, the maintenance of local cultures and lifestyles, and communal ownership, are discussed in this section. Our limited purpose during the first year has been to begin to identify and define these problems.

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[1] U.S., Federal Trade Commission, Bureau of Competition. Report to the Federal Trade Commission on Mineral Leasing on Indian Lands. Washington, D.C.: Federal Trade Commission, 1975, pp. B-17. According to the Bureau of Competition report, neither the Bureau of Indian Affairs (BIA) nor U.S. Geological Survey (USGS) have conducted a study of potential oil and gas reserves or of geothermal resources on Indian lands. The Navajos have had their reservation surveyed and estimate that they have up to 100 million barrels of oil and 25 trillion cubic feet of gas. USGS was defining the known geothermal resource areas on the Navajo Reservation at the time the Bureau of Competition report was published.

[2] This estimate of 50 reservations is based on a count made using the Hammond Medallion World Atlas. Maplewood, N.J.: Hammond, 1971, and 1:500,000 scale USGS maps of the eight states.

14.8.2 The Status of Indian Lands

Many of the problems and issues likely to arise when Indian-owned resources are developed will result primarily from the former status of Indian tribes as sovereign nations. When these tribes were incorporated into the U.S., their external powers were terminated and they were made subject to the legislative power of the U.S. However, except as modified by treaty or the express provisions of federal legislation, the tribes still possess the powers of local self-government.[1] In exchange for giving up their status as separate nations, the tribes were given federal aid, protection, and land grants. This led the U.S. Supreme Court to conclude that reservations are unique legal entities over which state governments have no powers not expressly given to them by the Congress.[2]

Legal title to Indian lands is held by the federal government as trustee for the Indians, who retain beneficiary rights such as the right to use, occupy, and, within limits, manage and dispose of these lands.[3] The Secretary of the Interior has been delegated the trusteeship responsibility; in turn, he has delegated it to the Commissioner for Indian Affairs (who heads the Bureau of Indian Affairs). By law, the discretion of the Commissioner and the Secretary is limited by their trusteeship role. In practice, their discretionary role is becoming even more limited because Indians are increasingly pressing for self-determination and the leaders of some tribes are becoming more aggressive in managing their own affairs, including resource development.

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[1] See Price, Monroe E. *Law and the American Indian*. Indianapolis, Ind.: Bobbs-Merrill, 1973.

[2] *Williams v. Lee*, 358 U.S. 217 (1959). See U.S., Commission on Civil Rights, *The Navajo Nation: An American Colony*. Washington, D.C.: Commission on Civil Rights, 1975.

[3] The vesting of legal title to Indian lands in the U.S. government was established by the U.S. Supreme Court decision in *Johnson and Graham's Lessee v. McIntosh*, 21 U.S. (8 Wheat.) 240 (1823). On the general status of Indian lands see: U.S., Federal Trade Commission, Bureau of Competition. *Report to the Federal Trade Commission on Mineral Leasing on Indian Lands*. Washington, D.C.: Federal Trade Commission, 1975, especially Chapter 2; and Commission on Civil Rights. *Navajo Nation*.

The status of Indian reservation as unique legal entities and of Indian lands as a trust held by the federal government for the benefit of Indians affects development of Indian-owned energy resources beginning with the acquisition of rights to develop and carrying through the various phases of the actual development.

A. Development Rights

The Omnibus Mineral Leasing Act of 1938 authorizes the leasing of unallotted or tribal and ceded lands for mining purposes.[1] Under this Act, the tribal council or other authorized spokesman for the tribe may, with the approval of the Secretary of the Interior, enter into a lease not to exceed 10 years "and so long thereafter as minerals are produced in paying quantities".[2]

Current regulations require competitive bidding on oil and gas leases and for other minerals unless the Commissioner of Indian Affairs grants the tribe written permission to negotiate for a lease.[3] Lease size is limited to 2,560 acres unless the Commissioner finds that a larger acreage is in the interest of the tribe and required"...to permit the establishment or construction of thermal electric power plants or other industrial facilities on or near the reservation".[1]

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[1] Omnibus Mineral Leasing Act of 1938, 52 Stat. 347, 25 U.S.C.A. §§ 396a *et seq.* (1963).

[2] Unallotted or tribal lands are held in trust by the federal government for an entire tribe; allotted lands are held in trust for individual Indians; and ceded lands are those which were ceded to the federal government and settled by non-Indians while the tribe retained the mineral rights. Authorization to lease allotted lands was legislated in 1909 (Indian Department Appropriations Act of 1909, 35 Stat. 783, 25 U.S.C.A. § 396 (1963)). While there are differences, because lands are held in common in one case and by individuals in the other, the regulations and procedures for allotted lands discussed here are essentially the same. Regulations implementing the Act are contained in Title 25, Code of Federal Regulations, Part 171 (25 C.F.R. 171.2 and 171.3)(1976).

[3] 25 C.F.R. 171.2 and 171.3 (1976).

Rents and royalties are also established by regulation. For oil and gas, the rent is $1.25 per acre per year, and the minimum royalty is 12.5 percent of the value of all oil and gas actually produced. For other minerals, the minimum annual rental is $1.00 per acre per year, and the minimum royalty is 10 percent, except for coal which is a minimum of $0.10 per ton.[2]

Regulations require diligent development. In the case of oil and gas, the regulation simply states that lessees are to exercise diligence in drilling and operating wells; for other minerals, a minimum annual development expenditure of not less than $10.00 per acre is required.[3] There is also a conservation requirement for oil and gas but not for other minerals.[4]

Under the current system, leasing is the sole mechanism emphasized in the regulations, and the initiative for minerals development (e.g., in initiating a lease sale) rests with the Secretary of the Interior. The theme throughout the regulations is one of management by the federal trustee for the Indians. As noted earlier, many individual Indians and Indian tribes wish to have a more active role in managing their own affairs. Some tribes have, in fact, departed from current regulations and dealt directly with energy companies without the prior approval of the Secretary of the Interior.[5] While the reasons for bypassing the Secretary and the BIA vary, there seem to be at least two common themes: a manifestation of independence in the spirit of self-determination, and a general antipathy toward the BIA because of what are perceived to be its past sins against Indians. Rightly or wrongly, some individual Indians and some tribes believe that they have been cheated in some of the agreements entered into at the initiative or with the approval of the trustee. Recent cases in point are the 1969 and 1971 Northern Cheyenne coal lease sales which the tribe petitioned to have rescinded because of alleged procedural irregularities and failure of the Secretary to uphold his trust responsibility.[1] In another case, the Jicarilla Apaches have filed a class action suit against the Secretary and about 20 lessees seeking cancellation of 100 leases covering 250 thousand acres which were let between 1970 and 1972. The suit alleges that the Secretary failed to comply with the National Environmental Policy Act[2] and that the procedures prescribed by current regulations were not followed.

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[1] 25 C.F.R. 171.9 (1976).

[2] 25 C.F.R. 171.14 and 171.15 (1976).

[3] 25 C.F.R. 171.14 (1976).

[4] 25 C.F.R. 171.19 and 171.21 (1976). Other regulations cover assignment (transfer) of leases, penalties, prospecting permits, inspection, prior approval for starting operations, and cancellations. 25 C.F.R. 171.18, 171.19, 171.20, 171.25, and 171.27 (1976).

[5] For example, the Navajos dealt directly with Exxon in negotiating an uranium lease in 1972. Although bypassing the Secretary violates existing regulations, such an agreement would be valid if he subsequently approved it. Although the purpose of these so-called "joint ventures" is to secure a competitive advantage in the leasing market, this one agreement seems to have had little effect on competition for resources. See U.S., Federal Trade Commission, Bureau of Competition. Report to the Federal Trade Commission on Mineral Leasing on Indian Lands. Washington, D.C.: Federal Trade Commission, 1975, pp. 161-171.

In addition to wanting a more active role in the development of their resources, some tribes have shown considerable interest in alternatives to leasing. For example, the Jicarilla Apaches are preparing a proposal for joint ventures in oil and gas resource development.[3] Other alternatives being discussed are modified leases (e.g., with variable rather than fixed royalty rates), production sharing agreements, and service contracts.

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[1] Initially, the tribal council passed a resolution directing the Secretary to withdraw his approval and to cancel the leases and all prospecting permits because of failure to comply with 25 CFR Part 177. This was followed by a formal petition and a "Summary of Points of Law Affecting the Validity of Coal Permits and Leases on the Northern Cheyenne Reservation". Although the Secretary declined to cancel the leases and permits, he refused to approve any development plans, such as mining plans, new leases, and permits until the tribe and coal companies reach agreement on "the terms and conditions upon which development may proceed on the Northern Cheyenne Reservation. . ." See further Simonds, Jerome H. "The Acquisition of Rights to Prospect for and Mine Coal from Tribal and Allotted Indian Lands," pp. 125-162 in Rocky Mountain Mineral Law Foundation. *Rocky Mountain Mineral Law Institute: Proceedings of the Twenty-First Annual Institute*, July 17-19, 1975. New York, N.Y.: Matthew Bender, 1976. To date, no joint agreement between the tribe and the coal companies has been reached.

[2] National Environmental Policy Act of 1969, § 102(2)(C), 42 U.S.C.A. § 4332(2)(c) (1973).

[3] The tribal council considers the standard lease to be unacceptable and does not intend to use it in the future."

Beginning with a national conference in Reston, Virginia in September 1974, the Americans for Indian Opportunity has either sponsored or co-sponsored a series of regional conferences on development of Indian-owned resources during the past two years. Participants in these conferences, typically members of tribal councils and directors of tribal development activities, have been introduced to a range of alternatives to leasing.[1]

Through such conferences and a variety of other means, Indians are learning more about the alternatives available to them, and, as the actions of the Jicarilla Apaches illustrate, they have been letting the Secretary of the Interior and the Commissioner of Indian Affairs know that they are dissatisfied with current procedures and regulations.[2] In fact, new regulations are in draft and, although not yet cleared by the Department of Interior, they would introduce major changes responsive to at least some of the expressed desires of Indians. These changes include: eliminating the current emphasis on leasing and adding provisions which will allow other alternatives, such as joint ventures; assigning tribes the initiative as to when they wish to develop their resources, with or without the Secretary's (and Commissioner's) assistance as the tribe desires; eliminating the requirement of having the Secretary's approval before entering into negotiations; and requiring economic, environmental, and social and cultural impact assessments prior to any agreement being approved by the Secretary.[3] However, even if all these regulations are adopted, resource development agreements will still need the Secretary's approval because this is a statutory requirement (the Omnibus Mineral Leasing Act).

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[1] Americans for Indian Opportunity is a non-profit organization now located in Albuquerque. The disadvantages of leasing and the potential advantages of alternatives have been discussed at their conference by Charles Lipton, an international lawyer and advisor to developing nations in minerals resource development, and Mr. A. David Lester, Director of the United Indian Development Association. Indian tribes as developing nations is another theme that has been introduced into these conferences. This analogy has been discussed by Guy Erb, Senior Fellow with the Overseas Development Council.

[2] Although the Jicarilla Apaches have not formally submitted their proposal to the Secretary, the BIA has been made aware of it and the AIO invited the Commissioner to each of its conferences on the development of Indian-owned resources where the participants let him know of their dissatisfactions.

[3] Proposed regulations appeared in 42 Fed. Reg. 18083-99 (April 5, 1977), too late to incorporate into the text of this report.

Assuming that, when issued, the new regulations are similar to the current draft, many Indians may generally be satisfied with the provisions, which give them much greater control over when and how tribal energy resources will be developed. Some tribes are likely to take advantage of these changes and enter into agreements which will let them retain control after a development right has been given and receive a larger portion of the benefits of resource development, not only in dollars but in training and employment benefits as well. However, other tribes will still need the help of the Secretary and the BIA. Some of these tribes will probably prefer to continue to use either the standard lease, or some modified version of it, even though they realize that they might increase their income by entering into other kinds of agreements. There are several reasons for this: several of the alternatives to leasing can expose tribes to liabilities and possible losses in a way that leases do not; some tribes lack the required expertise to deal with the relative complexity of most of the alternatives to leasing; and some tribes will be concerned that developers might go elsewhere if the cost of development on Indian reservations becomes too high.[1]

The major benefits of the new regulations will be the flexibility, control, potentially greater income, and self-esteem they provide to Indians. Thus, the trusteeship responsibility of the Secretary of the Interior and the Commissioner of Indian Affairs will probably be more difficult to meet, primarily because, given the current level of Indian consciousness and emphasis on self-determination, the Secretary will find it difficult to disapprove agreements he believes are not in the best interest of Indians. Conversely, the greater freedom given Indians to control their affairs may well make vigilance by the Secretary and the Commissioner even more important than it is now. The system will be predisposed toward approving what Indian leaders want to do, perhaps to the point of not providing adequate protection to Indians, particularly if the BIA does not receive funding for additional professionally competent staff.[1] This is just the reverse of what some critics argue has happened in the past; that is, that the system was predisposed to approve what the developers wanted to do. But this brief discussion merely points up the tensions inherent in the trust arrangement. What most Indians seem to want is self-determination but with the protection of the trust system. Providing them both may well prove to be a practical impossibility.

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[1] All three of these reasons were cited by Charles Lipton, an international lawyer and advisor to developing nations in minerals resource development, at the AIO regional conference at Sunrise Lodge at Fort Apache Reservation, June 21-23, 1976. The exposure question is still being debated. Lipton apparently believes that agreements acceptable to private developers can be drafted which will not expose the tribe to legal liability and minimize, if not eliminate, any financial risk. Some of the tribal resource development managers at the Sunrise Lodge conference doubt that this will be possible for most resource-owning tribes.

B. Regulation and Control over Development

Basic regulations applicable to development on Indian lands include specifying the measures to be taken during mining operations to avoid, minimize, or correct damage to the environment and hazards to public health or safety. Implementation of these regulations is the responsibility of the BIA superintendent. He is responsible for a technical examination of the likely effects of a proposed exploration or surface-mining operation, taking into account:

> the need for the preservation and protection of other resources, including cultural, recreational, scenic, and ecological values; and control of erosion, flooding, and pollution of water; the isolation of toxic materials; the prevention of air pollution; the reclamation by revegetation, replacement of soil, or by other means, of lands affected by the exploration or mining operations; the prevention of slides; and the protection of fish and wildlife and their habitat.[2]

Based on the results of this technical examination, the superintendent establishes the general requirements which the applicant must meet. When accepted by the developer, these requirements are incorporated into the permit or lease.[3] In addition, the developer is required to file exploration and mining plans with the U.S. Geological Survey mining supervisor, which must be approved before operations can begin. Both plans generally require the operator to describe the area to be explored or mined, state what exploratory or mining methods are to be used, and describe the measures to be taken to prevent or control damage to the environment and hazards to health and safety. In addition, the mining plan must give an estimate of how much water will be used, what pollutants are expected to enter into either surface water or groundwater systems, and a description of the reclamation plan.[1]

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[1] The BIA's critics already say that it lacks the requisite expertise in development planning to meet its responsibilities. Even if the critics are wrong, added requirements for impact assessments, particularly social and cultural impacts, and the evaluation of complex alternatives to leasing will likely be beyond the BIA's capabilities.

[2] 25 C.F.R. 177.4 (1974).

[3] 25 C.F.R. 177.4 (1974). This provision implies negotiations between the superintendent and the lessee. Failure to agree would prevent development of the lease.

Operators are also required to post a performance bond in an amount adequate to provide for reclamation.[2] Periodic reports are required in which operations are described, affected areas identified, the nature of the mining effects described, the number of acres disturbed and reclaimed stated, and reclamation methods, results, and work remaining to be accomplished are described.[3] A report is also required when grading and backfilling has been completed. Completion of this work has to be approved by the mining supervisor.[4]

In addition to the legislation and regulations specifically addressed to minerals development operations on Indian lands, Indian tribes and developers on Indian lands must comply with Federal statutes of general applicability.[5] These include such statutes as the Clean Air, Noise Control, Federal Water Pollution Control, Solid Waste Disposal, and Safe Drinking Water Acts.[6] Requirements established by such statutes are discussed in sections dealing with air, water, solid wastes, and other issues for the site-specific scenarios. The discussion here is limited because the problems and issues arise primarily in areas where Indian tribes are not specifically mentioned in these statutes, particularly where the statute calls for implementation by state governments and provides for funding assistance of some kind to state and local governments.[1]

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[1] 25 C.F.R. 177.7 (1976).

[2] 25 C.F.R. 177.8 (1976). This bond must be at least $2 thousand; however, the amount may be reduced "where the circumstances are such as to warrant an exception".

[3] 25 C.F.R. 177.9 (1976).

[4] Reclaimed areas must be inspected after the first full growing season to determine whether a satisfactory growth has been established.

[5] General applicability means that the statute applies to all persons.

[6] Clean Air Act of 1970, 84 Stat. 1676, 42 U.S.C.A. §§ 1857 *et seq.* (Supp. 1976); Noise Control Act of 1972, 86 Stat. 1234, 42 U.S.C.A. §§ 4901 *et seq.* (1973); Federal Water Pollution Control Act Amendments of 1972, 86 Stat. 816, 33 U.S.C.A. §§ 1251 *et seq.* (Supp. 1976); Solid Waste Disposal Act of 1965, as amended 84 Stat. 1227, 42 U.S.C.A. §§ 3251 *et seq.* (1973); Safe Drinking Water Act of 1974, 88 Stat. 1660, 42. U.S.C.A. §§ 300g *et seq.* (Supp. 1976).

J. Kemper Will, Assistant Regional Counsel in the Environmental Protection Agency's (EPA's) Denver office, has attempted to determine EPA's authority regarding Indian tribes, including a determination of which environmental protection statutes apply to Indian lands, when Indian lands are subject to state implementing legislation, and when Indian tribes are included in funding assistance programs.[2] His "Questions and Answers on EPA's Authority Regarding Indian Tribes" is intended to provide guidance on the applicability of EPA's enabling statutes to Indian lands.[3] According to Will, Indian tribes are required to comply with federal pollution standards because all EPA's enabling statutes are of federal applicability and these statutes generally authorize EPA to establish environmental standards applicable to Indian lands. In general, state implementing statutes do not apply to Indian lands unless the enabling statute explicitly confers jurisdiction over Indians to the state. EPA does not interpret its enabling statutes as conferring implementation and enforcement jurisdiction over Indians to the states; however, as Will indicates, there is considerable debate on this question and he summarizes EPA's position by stating that:

> Where there is a dispute over conflicting Tribal-State jurisdiction, EPA will not attempt to alter or define the present legal relationship. Thus, where States have not assumed jurisdiction over reservations, EPA will accept, within the constraints of EPA statutes, the proposals by Indian governing bodies of their own pollution standards.[4]

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[1] Several environmental statutes do call for state implementation and provide planning and other kinds of assistance to state and local governments.

[2] Will, J. Kemper. *Questions and Answers on EPA's Authority Regarding Indian Tribes*. Denver, Colo.: Environmental Protection Agency, Region VIII, 1976.

[3] Will's paper has not been adopted as official EPA policy.

[4] Will. *EPA's Authority*.

As this statement implies, Indian tribes possess independent authority to establish their own pollution standards so long as they are consistent with EPA authority.[1]

Will also comments on the applicability of specific statutes and whether Indians are eligible for assistance programs. In brief, he concludes that:

(1) The language in Sections 401(a) (1), 402(b) and 405(c) of the Federal Water Pollution Control Act Amendments (FWPCAA) of 1972[2] is ambiguous as to whether Indians are subject to state water discharge permit programs. EPA treats Indian reservations as it does federal facilities. That is, "...the Administrator will provide the certification except where the state has other independent jurisdiction over the Indian lands where the discharge will originate."[3]

(2) States have the authority to designate Indian reservations as a FWPCA Section 208 area (for areawide waste treatment management plans).[4]

(3) Indian tribes or designated tribal organizations are authorized to receive EPA funds for FWPCA pollution control activities, including Section 208 funding.

(4) Although Indians are not mentioned specifically in the Clean Air Act of 1970, a broad reading of the term "air pollution control agency" would qualify Indian tribes to receive EPA contracts or grants. In November 1975, EPA Administrator Russell E. Train stated in a letter to Senator Domenici of New Mexico that "EPA's basic regulations for developing State Implementation Plans under Section 110 of the Act, and for

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[1] *Colliflower v. Garland*, 342 F. 2d 369 (2d Cir. 1965).

[2] Federal Water Pollution Control Act Amendments of 1972, 86 Stat. 816, 33 U.S.C.A. §§ 1251 *et seq*. (Supp. 1976)

[3] Will, J. Kemper. *Questions and Answers on EPA's Authority Regarding Indian Tribes.* Denver, Colo.: Environmental Protection Agency, Region VIII, 1976.

[4] The 208 planning program is discussed in Section 14.5. Will's interpretation may be in conflict with EPA General Counsel G. William Frick's opinion stated in the memorandum discussed in footnote number three on the next page.

providing federal grant support for air pollution control agency programs under Section 105 of the Act, do not have provisions for Indian lands."[1]

(5) A broad interpretation of the term "local government" in Section 14 of the Noise Control Act of 1972 would authorize the Administrator to fund research by Indian tribes on the effects and control of noise.[2]

(6) Both the Solid Waste Disposal Act as amended in 1970 and the Safe Drinking Water Act of 1974 specifically include either Indian tribes and/or tribal organizations in their definition of municipality. This authorizes the Administrator to enter into contracts with or make grants to Indian tribes.[3]

(7) Government approval of an exploration permit or a mining lease on Indian lands constitutes a major federal action and an environmental impact statement required.[4]

(8) 25 C.F.R. Section 1.4 restricts the applicability of any state or local land use controls such as zoning to Indian lands held in trust. However, the Secretary is authorized to make such laws

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[1] Quoted by Will J. Kemper. Questions and Answers on EPA's Authority Regarding Indian Tribes. Denver, Colo.: Environmental Protection Agency, Region VIII, 1976, p. 8.

[2] Ibid., p. 8.

[3] Ibid., p. 9. In a memorandum to EPA's Deputy Assistant Administrator for Water Supply dated December 8, 1976, EPA General Counsel G. Williams Frick concluded that a state cannot claim the authority to enforce state primary drinking water regulations against reservation Indians on the basis of Public Law 280 as amended by Title IV of the Civil Rights Act of 1968.

[4] National Environmental Policy Act of 1969, § 102(2)(c), 42 U.S.C.A. § 4332(2)(c) (1973). It is the approval which constitutes the major federal action. See Cady v. Morton, 527 F. 2d 786 (9th Cir. 1975) and Davis v. Morton, 469 F. 2d 593 (10th Cir. 1972).

> applicable when that would be in the best interest of the Indian land owners.[1]

As mentioned in the section on leasing, the current basic regulations are being revised which would give Indians greater control over development, including greater control over environmental protection and public health and safety. In particular, the changes incorporated into the draft are responsive to the widespread desire among Indians to determine for themselves whether, where, when, and how their resources are to be developed. Among the major changes will be a greater emphasis on attempting to assess in advance likely social and cultural impacts, specifically the impacts that can be expected to affect local Indian populations, the local culture and religions, life-style, "quality of life" (in such areas as the influx of non-Indians and overloading social service delivery systems), and aesthetics (in such areas as noise levels and visual impacts).

A major omission from the regulations in the current draft is a provision dealing with those cases where a tribe has established its own development rules and regulations. Some tribes, particularly the larger resource-rich tribes, are likely to develop a tribal code of regulations equivalent to 25 C.F.R. Part 177 and/or include development regulations and controls in the agreements they negotiated with developers.

In most environmental legislation calling for state implementation of federal standards, as in air and water quality for example, a provision is included which establishes federal standards as minimums. While states can establish more stringent standards, they cannot establish standards that are less stringent. It is likely that such a provision will be added to the revisions being considered for 25 C.F.R. part 177, and the provision will likely cover both the contingency when the tribe enacts its own code of regulations and when the tribe incorporates development regulations into its agreements with the developer. Without such a provision, either in the controlling legislation or in the revised 25 C.F.R. Part 177, it will be more difficult for the Secretary and the Commissioner to fulfill their responsibilities as trustees.

The most difficult issues to resolve in regulating and controlling the development of energy resources on Indian reservations are likely to arise as a consequence of the unique legal status of Indian lands and jurisdictional ambiguities raised by federal statutes of general applicability that fail to specify whether and/or how they apply to Indians and Indian lands. These, of course, are not new questions, but they are now being raised within the context of a greatly increased emphasis on self-determination for Indians and, as was discussed in Chapter 13, expanding policymaking roles for state governments which often include primary responsibility for implementation and enforcement.

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[1] Will, J. Kemper. *Questions and Answers on EPA's Authority Regarding Indian Tribes*. Denver, Colo.: Environmental Protection Agency, Region VIII, 1976, p. 4. To date, only the zoning laws of the state of California are applied to reservations.

14.8.3 Maintaining Local Indian Cultures and Life-Styles

The effects of energy development on local Indian cultures and lifestyles are a major concern of many Indians. In fact, some tribes have decided not to develop their resources rather than accept what they consider to be the likely negative cultural and lifestyle impacts. For example, as indicated in the analysis of the impacts at Navajo/Farmington, some Navajos are questioning the development decisions made by the Navajo Tribal Council, in part because they question the desirability of having large numbers of non-Indians on the Reservation.

Lifestyle and cultural impacts of energy resource development on the Navajo Reservation were examined briefly in Chapter 7, and, as indicated earlier, field research is being conducted on the Navajo reservation as a part of this study. This field work includes surveying Navajo attitudes toward development, especially concerning lifestyle and cultural impacts.[1]

Social and cultural problems and issues are often as difficult to assess as are the impacts which give rise to them. The more difficult of these, such as lifestyle and cultural problems associated with energy development on Indian reservations, have received only preliminary attention during the first year. However, despite this limitation, development of energy resources on Indian lands will almost certainly increase and intensify the exposure of many reservation Indians to non-Indians and non-Indian cultures and lifestyles. Exposure will almost certainly have an impact on Indians, both as individuals and as tribes. For example, to become effective as managers of their own resource development, Indians must adapt to and become effective participants within the predominately white business system. Also, if tribal councils require developers to train Indians and establish employment quotas, increasing numbers of tribal members will probably modify their lifestyles. In short, the effects will be myriad, difficult to assess, and almost impossible to control effectively.

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[1] Field work also includes collecting data relating to the assessment of terrain types. Work completed during June 1976 indicates that published data by reservation vegetation types and resources are seriously flawed.

For most if not all tribes, complete isolation is not an option. Consequently, when faced with the question of whether to develop their energy resources, the choice is not whether tribal members will be exposed to different cultures and lifestyles but whether to increase and intensify the existing exposure. Alternatives range from no development to the most extensive and rapid development possible, and they include a variety of choices as to the mix of Indians and non-Indians to carry out the development. Given a right to determine for themselves, whether, when, and how to develop their resources, tribal councils and tribes will have to decide among these alternatives.

14.8.4 Communal Ownership

The research team's brief examination of the special problems associated with the development of energy resources on Indian lands led to the identification of another set of issues of obvious concern to many Indians. These are the issues that arise from communal ownership of tribal resources. Most tribes manage tribal enterprises either through a committee of the tribal council or through a separate board of directors. Apparently neither choice insures against the sometimes undesirable intrusion of tribal politics. When the separation of politics and business is minimal, tribes not only experience the discontinuities associated with periodic changes in leadership but also find that financial institutions and would-be developers are leery about making long-term loans or agreements. The role of the tribal council with regard to the tribes' resources also makes tribal leaders vulnerable to the charge that they have approved lease sales, development contracts, etc., because of the personal benefits that they have received. Since not enough is known at this point to be able even to define the problem, this situation should be examined in more detail, including the identification of alternative ways for tribes to manage their business activities more effectively.

Some Indian leaders are becoming concerned about another problem in this category, the role of individual Indian entrepreneurs in the development of tribal resources. Philosophically, the basic question is whether there is an inherent tension between communal ownership and opportunities for individual entrepreneurs. Again, the research team's knowledge is too limited to do more than pose a problem that should be examined in more detail.

14.9 REFINEMENT AND EXTENSION OF POLICY ANALYSIS

In the preceding sections, an effort has been made to identify and begin to define some of the principal problems and issues in western energy resource development that policymakers and administrators must attempt to resolve. The categories singled out for preliminary discussion were water availability and quality, reclamation, air quality, growth management, housing, community facilities and services, and Indians. These problems and issues are widely perceived to be significant, and, for the most part, they were identified apart from the impact analyses conducted during the first year. This focus is largely a consequence of timing since the impact analyses for the site-specific scenarios were not completed in time to be used in most of the policy papers.

A major emphasis during the remainder of the project will be to define these discussions and to extend the breadth of the policy analysis to include identification and definition of problems and issues that surface as a result of the impact analyses. For those categories already introduced, the primary effort will be to refine definitions of the issues and problems, including an elaboration of what can be done to eliminate, reduce, or enhance an impact. Whereas the foregoing discussions concentrate mostly on governmental parties-at-interest, non-governmental actors will be identified to address the potential conflicts that may arise as policymakers seek to accommodate a wide range of interests and values. In addition, more detailed attention will be given to the functional relationships among policymaking structures and institutions. This will necessarily include identifying, evaluating, and comparing alternative policies and implementation strategies. The costs, benefits, and risks of each will have to be calculated employing a range of quantitative and qualitative measures that will inform policymakers about trade-offs implicit in the choices that are available to them. The work plan described in Chapter 5 of this report discusses how these tasks will be completed.

In addition to the categories of problems and issues discussed in this chapter, energy facility siting and transportation are illustrative of the additional problems and issues that will receive more attention during the next two years.

Siting energy facilities in the western states seems to raise more controversy than those other types of industrial siting. While manufacturing industries are generally perceived as long-term ventures that can be used to promote continued economic growth, new energy facilities often appear to be short term. They are perceived as generally exploiting resources to alleviate a short-term demand subject to substantial regional and national fluctuations. As a result, states are increasingly seeking to gain and exercise control over plant siting, location, and pace of development decisions. These actions raise a number of problems and issues with regard to federal-state relations where the federal government owns the resource lands and leases them to energy promoters. Moreover, they raise critical problems and issues related to water availability and quality at particular locations.

A broad range of transportation problems and issues that have now been surfaced by the impact analyses also warrant special attention, including eminent domain for slurry pipelines, subsidies to railroads to improve road beds, rate structures, and local control over nuisances such as blocked crossings and noise levels. Given the quantities of energy resources that are projected to be transported out of the West, these and other transportation-related problems and issues assume major importance for policymakers concerned with western energy resource development.

GLOSSARY

ACID MINE DRAINAGE--Acid water formed by oxidation of iron pyrite (FeS) flowing from an area affected by mining.

ACID RAIN--The decrease in pH of rainfall linked to the presence of nitrate, sulfate, and chloride ions in the atmosphere.

ACID SOIL--A soil that is acid in parts occupied by plant roots; typically, a soil more acid than pH 6.6.

ACRE-FOOT--The quantity of water required to cover 1 acre to a depth of 1 foot (approximately 325,000 gallons).

AD VALOREM TAX--A tax imposed at a fixed percentage of the value of a commodity.

AEROSOL--Very fine solid or liquid particles dispersd in a gas.

AGE/SEX DISTRIBUTION--The proportions of a given population that fit into specified age and sex categories.

AGGREGATE--Rock materials, such as gravel, used to form concrete.

AIR STAGNATION--A condition in which an air mass does not move or disperse over a long period of time. Little mixing or ventilation occurs to rid the air of pollutants (see Trapping).

ALDEHYDE--Any of various highly reactive organic compounds containing a CHO group.

ALKALINE SOIL--A soil that is alkaline in parts occupied by plant roots; typically, a soil having a pH value above 7.3.

ALLUVIAL--Associated with materials (sand, gravel, etc.) transported by and laid down by flowing water.

AMBIENT CONDITIONS--The normal physical environment conditions in the vicinity of a reference point.

AMBIENT AIR QUALITY STANDARDS--See Primary ambient air quality standards and Secondary ambient air quality standards.

AMINE--Any of various organic compounds containing the chemical group NH_2, NH, or N and a hydrocarbon group such as CH_3.

ANCILLARY ENERGY--That energy required from external sources to accomplish an activity or process.

ANCILLARY FACILITIES--Those support facilities required to accomplish an activity or process.

APPROPRIATION SYSTEM--One means by which surface water use is regulated, granting a first user of water a continuing right to that use. Hence, later users face greater risks for a continued supply of water (see Beneficial Use).

AQUIFER--A water-bearing geological formation such as permeable rock, sand, or gravel through which water moves more readily than in adjacent formations with lower permeability.

AREA MINING--A surface-mining technique used in flat terrain.

ASH--The residue left when combustible material is burned or otherwise oxidized (see *slag*).

ASSESSED VALUATION--The value of property for tax purposes, which is usually derived from fair market value and may vary between jurisdictions and types of property.

AVERAGING TIME--The time interval over which air pollutant concentrations are measured. The average of the measured values taken in the time interval is the concentration for an averaging time.

A-WEIGHTED SOUND LEVELS--Sound estimates approximating the capability of the human ear to discern the relative noisiness or annoyance of common sounds.

BACKFILLING--A reclamation technique which returns the spoils to mined cuts or pits. This leaves the land in a configuration similar to the original form.

BANK STORAGE--Water absorbed and stored in the bed or banks of a stream or reservoir and returned in whole or part as the water recedes.

BASELINE CONDITIONS--The state of such factors as air quality, water quality and quantity, solid waste, noise, land use, ecology, resource availability, economy, and social structure that may prevail in an area in the absence of the developments being studied.

BASELINE INFORMATION--Data gathered about the characteristics of a site prior to the development of an energy facility.

BASE LOAD--The normal minimum weekly output of electrical generation stations, which is produced by base-load units (q.v.).

BASE-LOAD UNITS--Large (e.g., 1,000-megawatt) electric power generation units which are relatively efficient (32-40%), are run almost continually at full load, and are used to supply the majority of the demand for electricity (see peaking units).

BASIC EMPLOYMENT--See Economic Base Model.

BASIC STABILITY WINDROSE INFORMATION--The frequency of occurrence of various wind speed/wind direction combinations as a function of one of the six Pasquill stability classes (q.v.). The distribution contains 16 wind direction categories and 6 wind speed categories.

BASIN--A geologic or land-surface feature which is lower in the center and higher at the sides. Geologic basins may be filled with sediment and not visible from the surface.

BED--A stratum of coal or other sedimentary deposit.

BEDROCK--Any solid rock underlying soil, sand, clay, silt, or other earthy materials.

BENCH--A flat excavation.

BENEFICIAL USE--A doctrine derived from the appropriation system (q.v.) stipulating that water use must be made in accordance with the public interest of the best utilization of the water resource.

BENEFICIATION--Cleaning and minimal processing to remove major impurities or otherwise improve properties of extracted minerals.

BERM--A shelf or wall built to contain spills around a fuel storage tank or to retain other liquids or semisolid materials as in waste stabilization ponds.

BIG GAME--Large mammals often hunted for sport.

BIOCHEMICAL OXYGEN DEMAND (BOD)--The amount of oxygen required by bacteria to convert organic material into stable compounds (see Chemical Oxygen Demand).

BIOLOGICAL OXYGEN DEMAND--See Biochemical Oxygen Demand.

BIOLOGICAL COMMUNITY--The populations of plants and animals that occur in and characterize a given area (see Ecosystem Units).

BIOMASS--The amount of living matter in a unit area or volume; i.e., the living weight.

BIOME--A major biological community (q.v.) type. Includes broad categories such as desert, coniferous forest, and grassland (see Ecosystem).

BITUMINOUS--An intermediate-rank (q.v.) coal with low to high fixed carbon, intermediate to high heat content, a high percentage of volatile matter, and a low percentage of moisture.

BLOWDOWN--The release or cleaning out of water with high solids content, the solids having accumulated each time water is used or evaporatus such as in a cooling tower (q.v.).

BONUS BIDDING--A method for making tracts of publicly owned land available for private development. The company or individual which submits the highest bid is awarded the tract. The lessee then pays the government the amount bid (the bonus) and a royalty on the resource extracted.

BOTTOM ASH--A waste product of coal combustion composed primarily of silica, alumina, and ferrous oxides. Bottom ash is heavier than fly ash and settles during combustion.

BRINE--Water saturated with large quantities of salt; i.e., a strong saline solution.

BTU (BRITISH THERMAL UNIT)--A measure of energy equivalent to the amount of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit. One kilowatt hour of electricity equals 3,412 Btu's; 1 Btu equals 0.252 kilocalories (q.v).

CAKE--To form or harden in a cohesive mass; to form a hard or brittle layer or deposit (see Caking Coal).

CAKING COAL--Coal which, when heated, passes through a plastic stage and agglomerates.

CARCINOGENIC--Cancer producing.

CATALYSIS--Modifications or increases in the rate of a chemical reaction induced by material unchanged chemically at the end of the reaction; any reaction brought about by a separate agent.

CATALYST--A substance which induces *catalysis* (q.v.).

CATALYTIC CONVERSION--A chemical reaction induced by a *catalyst* (q.v.).

CENTRIFUGAL SEPARATOR--A device which separates two fluids (or a fluid and a solid) of different densities by rotating them rapidly and forcing the denser material to the outside.

CHAR--A mixture of ash and carbon which remains after partial combustion or heating.

CHEMICAL OXYGEN DEMAND (COD)--The amount of oxygen required to convert (oxidize) organic compounds into stable forms, usually carbon dioxide and water. COD includes all compounds requiring oxidation while *Biochemical Oxygen Demand* (q.v.) includes only the biodegradable fraction.

CHINOOK WINDS--Warm, strong down-slope winds on the lee slopes of the Rocky Mountains.

CHRISTMAS TREE--The assembly of valves, pipes, and fittings used to control the flow of oil and/or gas from a well.

CLAUS RECOVERY PLANT--A facility that processes emission gas streams containing 10 percent or more hydrogen sulfide, oxidizes the hydrogen sulfide, and produces elemental sulfur of high purity.

CLAY--A fine-grained soil that is plastic when moist (see *Pond Liner*).

CLEAN AIR ACT AMENDMENTS (CAA)--The basis for much of the current regulation of air quality. Passed in 1970, the Clean Air Act mandates the Environmental Protection Agency to establish national ambient air standards and to protect the nation's clean air areas from "significant deterioration".

COKE--The solid, combustible residue left after the destructive distillation of coal, crude petroleum, or some other material.

COLORADO RIVER BASIN SALINITY CONTROL ACT--1975 statutes which enable the federal government and states of the basin to develop programs to reduce salinity to the levels agreed upon in a 1973 treaty with Mexico.

COLORADO RIVER COMPACT OF 1922--An agreement that provided for division of the waters in the Colorado River between the upper and lower basins, with approximately 7.5 million acre-feet allocated to each basin (see *Upper Colorado River Basin Compact-1948*).

CONTINUOUS MINING MACHINE--A single machine used in underground mining which accomplishes all the excavating, loading, and initial transportation operations.

CONTOUR MINING--A mining technique used in steeply sloped terrain where a seam outcrops on a slope. The mine follows the contour of the slope.

CONTROLLED CRUDE OIL--See Old Oil.

CONVECTION--A thermal process whereby atmospheric circulation is maintained through the upward or downward transfer of air; warm air tends to rise and cold air sinks.

COOLING POND--Usually a man-made body of water used in electrical power generation systems for dissipating waste heat, largely through evaporation.

COOLING TOWER--A large, normally cylindrical structure used for dissipating waste heat. Water is circulated between a condenser where it absorbs heat and a tower where the warm water is either cooled by evaporation (wet cooling tower) or circulated in a closed system and cooled by air flow similar to a car radiator (dry cooling tower). In Forced Draft Cooling Towers, air is moved by large motor-driven fans. In Natural Draft Cooling Towers, outside air is naturally drawn in at the base of the tower to replace the less dense, warm air which is rising out of the tower due to convection (q.v.).

COOLING TOWER DRIFT--Small water droplets contained in the exhaust flow from a cooling tower. The dissolved salt content of these droplets is the same as that in the circulating water.

COOLING TOWER FOGGING AND ICING--Cooling towers add moisture to the air (via cooling tower drift q.v.) which condenses and/or freezes, thus creating fog, ice, or an ice-fog under the proper weather conditions.

COOLING TOWER SALT DEPOSITION--The amount of salt deposited from cooling tower drift (q.v.) onto a given section of terrain.

CORE DRILLING--The process by which a cylindrical sample of rock or other strata is obtained through the use of a hollow drilling bit which cuts and retains a section of the strata penetrated.

COST/RISK/BENEFIT ANALYSIS--An assessment technique in which values are assigned to such concerns as social impacts to weigh the overall benefits and costs associated with recommended policy alternatives.

CRACKING--The process of breaking up large molecules in petroleum refinery feedstock to form smaller molecules with higher energy content (e.g., change crude oil into gasoline).

CRITERIA POLLUTANTS--Six air pollutants identified prior to passage of the Clean Air Act Amendments (q.v.) which now have established Ambient Air Quality Standards (q.v.); i.e., sulfur dioxide, particulate matter, carbon monoxide, photochemical oxidants, non-methane hydrocarbons, and nitrogen oxides.

CUTTING FACE--In an underground mine, the exposed portion of a coal seam where coal is removed.

CUTTINGS--Solid material removed from a drilled hole.

CYCLONE--A cleaning device which uses a circular flow to separate the heavier particulates from stack gases.

DECIDUOUS--A term describing trees that shed all their leaves every year at a certain season, typically winter.

DEDICATED RAILROAD--A system in which the right-of-way, rails, and rolling stock are used exclusively to transport a single resource.

DEMOGRAPHY--The statistical study of the characteristics of human populations.

DIRECT HEAT--The heating of a substance through immediate contact with a combustion zone.

DISPERSION MODEL--A set of mathematical formulations used to describe the way in which airborne pollutants will be distributed around their source.

DISPERSIVE TECHNIQUES--A method of controlling ambient air quality around power plants by using tall stacks (q.v.), which spread pollutants over a much wider area than do shorter stacks.

DISSOLVED SOLIDS--Those substances, typically salts, which are held in solution and will not settle out as opposed to suspended solids (q.v.).

DISTILLATION--The process of heating a liquid mixture to drive off gases or vapors which are then separated according to boiling point and condensed into different liquid products.

DOMINANT SPECIES--Plants or animals that, because of abundance, size, or habits, exert a major influence on the condition of an area.

DRAGLINE--An excavating machine used in open pit mines to remove overburden; basically, a crane with a bucket suspended on its line which is filled by dragging.

DRAINAGE BASIN--The area from which water is carried off by a drainage system, a *watershed* (q.v.) or a catchment area.

DRILL PIPE--In rotary drilling, the heavy seamless tubing used to rotate the bit and circulate the drilling fluid. Individual pipe lengths are normally 30 feet and are coupled with tool joints.

DRILL STRING--A column of pipe that connects to a bit used to bore holes for wells.

DRY COOLING TOWERS--See *Cooling Towers*.

DRY (GEOTHERMAL) SITE--A geothermal well which produces *dry steam* (q.v.).

DRY STEAM--Steam which is not mixed with a liquid water phase.

DYNAMIC METEOROLOGY--The study of atmospheric motions as solutions of the fundamental equations of hydrodynamics or other equations for special situations.

ECONOMIC BASE MODEL--A model which considers two employment sectors (*basic* or production for export and *non-basic* or production for local goods and services) to predict the impacts of exogenous changes on urban and regional economies (see *Multiplier*).

ECOSYSTEM--The interacting *biological community* (q.v.) and physical components that occur in a given area.

ECOSYSTEM UNITS--Vegetation units and their associated *fauna* (q.v.) and physical components (see *Ecosystem*).

EFFLUENT--Any water flowing out of an enclosure or source to a surface water or groundwater flow network.

EFFLUENT STANDARDS--Those standards under the *Federal Water Pollution Control Act Amendments* (q.v.) which limit the amount of a pollutant that is allowed to be discharged in a time period.

ELASTIC SUPPLY CURVE--The supply of a community which is very responsive to its price.

ELECTROSTATIC PRECIPITATORS--Devices that use an electric field to remove solid particles or droplets of liquid from plant exhaust stack gases.

ENDANGERED SPECIES--A species of fish or wildlife which is in danger of extinction throughout all or a significant portion of its range.

ENDOTHERMIC--Pertaining to, attended by, or produced from the absorption of heat, the opposite of exothermic (q.v.).

ENERGY EFFICIENCY--The ratio between the energy value of the output fuel and the energy value of the input fuel, usually expressed as a percentage. Also called Primary Efficiency.

ENERGY INTENSIVENESS--In transportation, the relative amount of energy required to move one unit (one passenger or 1 ton of cargo) a distance of 1 mile. In industry, the ratio of total energy consumed for each dollar of production goods shipped.

ENERGY RESOURCE DEVELOPMENT SYSTEM (ERDS)--A resource, the technologies required to develop it, and the social controls that are imposed when these technologies are deployed.

ENRICHMENT--A process by which the percentage of the fissionable isotope, U-235, is increased above that contained in natural uranium (q.v.).

ENVIRONMENTAL IMPACT STATEMENT (EIS)--The National Environmental Policy Act requires that an EIS be filed with any proposed federal action that will affect the environment. The EIS is to contain: a description of the proposed action; the relationship of the action to plans for the affected area; the probable impact (both favorable and adverse); alternatives to the proposed action; unavoidable adverse environmental effects; and the relationship between short-term uses and long-term productivity.

EQUITY--The net worth of a firm or corporation (total assets less total debts).

EXOGENOUS--Determined by factors outside a given system or model.

EXOTHERMIC--Refers to a chemical reaction that gives off heat; the opposite of endothermic (q.v.).

FAUNA--The animal life in a specified environment.

FEDERAL--Anything relating to or owned/controlled by the U.S. (national) government.

FEDERALISM--The mix of formal authority and responsibility shared by local, state, and national governmental units (see New Federalism).

FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS (FWPCAA)--1972 Statutes granting EPA authority to implement a National Pollution Discharge Elimination System with permits and effluent limitations, technological and planning requirements, assistance to municipalities, and a goal of eliminating the discharge of pollutants by 1985.

FEEDSTOCK--Raw materials supplied to a processing plant.

FERAL DOGS--Wild dogs.

FERROUS--Of, relating to, or containing iron.

FINE PARTICULATES--Particulates (q.v.) less than 2 microns in diameter.

FISCHER ASSAY--A standardized laboratory procedure that removes oil from oil shale, used as a basis for comparing oil shale processing alternatives and shale feedstocks.

FISSION--The splitting of an atomic nucleus, resulting in the release of energy.

FIXED BED--A coal combustion or gasification process in which the coal is burned on a stationary platform.

FIXED CARBON--The solid, non-volatile, combustible portion of coal.

FIXED CHARGE--Expenses that must be borne whether any business is done or not. The chief items are the company's interest on bonds or other external borrowings, some taxes levied by the government, insurance payments, and depreciation due to obsolescence.

FLORA--The plant life in a specified environment.

FLUE GASES--Gases (usually carbon dioxide, water vapor, oxides of nitrogen, and other trace gases) that result from combustion processes.

FLUIDIZED BED--A coal combustion or gasification process in which solid particles are suspended by the forced injection of a gas through the bottom of the vessel. The suspension behaves like a fluid.

FLUIDIZED BED BOILER--A new type of boiler with gases suspending a coal mixture (fluidized bed, q.v.) and designed to improve efficiency and reduce pollutants and boiler size.

FLY ASH--A lightweight dust, which is a waste product of coal combustion, carried by the stack gases (q.v.).

FORAGE--Plant material which is used as food by animals.

FORB--An herb other than grass.

FORCED DRAFT COOLING TOWERS--See Cooling Towers.

FORMATION (geology)--Earth deposits, mineral deposits, or rock masses having common physical characteristics or similar origin.

FRAGMENTATION--(1) The blasting of coal, ore, or rock into pieces small enough to load, handle, and transport; or (2) the scattered removal of habitat, leaving disconnected remnants.

FRONT END LOADER--A tractor with a large bucket mounted on arms that can scoop material and raise it for dumping into a truck.

FUMIGATION--Abnormally high pollutant concentrations resulting from the combination of an inversion layer (q.v.) and unstable atmospheric conditions below the layer which tend to bring plant plumes (q.v.) directly to the ground.

GAME FOOD--Numerous grasses, legumes, shrubs, and trees that typically provide sustenance and cover for wildlife.

GASIFICATION--The conversion of coal or organic waste to a gaseous fuel.

GENERATOR--A mechanism which converts mechanical energy to electrical energy.

GROUND-BASED INVERSION--An inversion layer (q.v.) at ground level. Such a layer traps an air mass and pollutants close to the earth.

GROUND COVER--Any living or dead vegetative matter on or just above the soil surface.

GROUNDWATER--Subsurface water occupying the saturation zone from which wells and springs are fed; in a strict sense, this term applies only to water below the water table.

GROWING SEASON--The season which generally is warm enough for the growth of many plants; the extreme limits from the date of the last killing frost in spring to that of the first killing frost in autumn.

GROWTH MANAGEMENT--Public sector mechanisms designed to deal with the rate, dispersion, and social effects of new or expanding communities. Growth management may include planning, social programs, legal guidelines, and fiscal management.

HAZARDOUS AIR POLLUTANTS--Those pollutants with no *ambient air quality standard* (q.v.) but which contribute to an increase in mortality or serious illness. These include asbestos, beryllium, and mercury. Hazardous air pollutants are an area of direct federal controls, beyond the control of *State Implementation Plans* (q.v.).

HEAT EXCHANGER--A device in which heat energy is transferred from one fluid to another due to a temperature difference between the two fluids.

HEAVY METALS--Metals with an atomic weight greater than about 40. Many occur in coal and some are toxic at higher than normal concentrations.

HIGH-BTU GAS--An equivalent of natural gas, predominantly methane, obtained by methanating synthesis gas which is provided from coal; energy content is usually 950-1,000 Btu's per cubic foot.

HIGHER ORDER GOODS AND SERVICES--Those goods and services that are purchased less frequently and are generally more expensive; they are available only in larger cities. The higher the order of goods or service, the larger the city which provides it (cf., *Lower Order Goods and Services*).

HIGH-LEVEL SOURCES--Tall *stack* (q.v.) that emit air pollutants several hundred feet above the ground.

HYDRATE--A compound or complex ion formed by the union of water with some other substance.

HYDROCARBONS--Organic compounds containing only carbon and hydrogen, characteristically occurring in petroleum, natural gas, coal, and bitumens. When in an air quality context, refers to non-*methane* (q.v.) hydrocarbons.

HYDROLOGY--A science dealing with the properties, distribution, and circulation of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere.

HYDROSTATIC HEAD--The pressure created by the height of a column of water.

IMPROVED RECOVERY TECHNIQUES--Methods of increasing the amount of oil extracted from a field by adding supplemental energy to the reservoir through the injection of gases, fluids, or heat.

INCREMENTALISM--A policy of political or social change in small increments.

INFILTRATION--Water entering the groundwater system through the land surface.

INFRASTRUCTURE--The set of capital facilities (roads, utilities, etc.) and social services (law enforcement, medical care, etc.) necessary to support the operation of a community.

INPUT-OUTPUT MODEL--A linear model which considers the flow of goods and services between industries to describe an economy and to predict the impacts from exogenous (q.v.) changes.

IN-SITU--In the natural or original position; applied to energy resources when they are processed or converted in the geologic strata where they were originally deposited.

INSOLATION--Solar radiation received on a given body or over a given area.

INTEGRATED TECHNOLOGY ASSESSMENT--See Technology Assessment.

INTERMITTENT CONTROL SYSTEMS--The manipulation of emission rates from electric power plants based on adjusting coal composition and plant operating levels to the existing or predicted meteorological conditions to maintain a specified level of ambient air quality.

INTERMITTENT STREAM--A stream that usually flows only in response to precipitation. It receives little or no water from perennial springs and is dry for a large part of the year.

INVERSION FREQUENCIES--The percentage of time that the ground layer of the atmosphere has temperature increasing with increasing height, thus inhibiting vertical mixing (q.v.) of air.

INVERSION LAYER--A layer of the atmosphere through which temperature increases as altitude increases, thus inhibiting vertical mixing (q.v.) of air (see Trapping).

KATABATIC CIRCULATION--Any wind blowing down an incline. If the wind is warm, it is called a foehn or chinook; if cold, it is usually a gravity wind in which cold, dense air drains to lower elevations.

KEROGEN--A solid, largely insoluble organic material occurring in oil shale (q.v.) which yields oil when it is heated but not oxidised.

KETONE--Any of various organic compounds containing a carbonyl group (CO) attached to two carbon atoms (C) (The carbonyl group is linked to hydrocarbon groups in the middle of the chain resulting in at least one hydrocarbon group on each side of the carbonyl group).

KILOCALORIE--1,000 calories; a unit of energy equal to 3.968 Btu's (q.v.) or the energy required to heat 1 kilogram of water 1 degree centigrade.

KINETIC ENERGY--The energy that an object possesses because it is moving; an object's Kinetic energy is determined by its mass and speed.

L_d--Daytime equivalent sound level; i.e., L_{eq} (q.v.) for daytime (0700-2200 hours).

L_{dn}--Day-night sound level; the cumulative L_{eq} (q.v.) for day and night. This measure takes into account the differences between human response to noise at night and during the day.

L_{eq}--The long-term equivalent of A-weighted sound levels (q.v.). It is measured in terms of a mean value, which is the noise level that is exceeded 50 percent of the time, and the standard deviation from that mean.

L_n--Nighttime equivalent sound level; i.e., L_{eq} (q.v.) for nighttime (2200-0700 hours). Human response to noise at night is different from daytime noise response and to be equivalent nighttime levels must be 10 decibels lower.

LEACHATE--Liquid that has percolated (q.v.) through a medium and has extracted dissolved or suspended materials from it.

LEACHING--The continued removal, by water (the leachate [q.v.]), of soluble matter from rock or soil.

LEAD TIME--The time needed for planning, financing, and construction of required facilities before they are ready for use.

LIGNITE--The lowest-rank (q.v.) coal, with low heat content and fixed carbon, and high percentages of volatile matter and moisture; an early stage in the formation of coal.

LIMESTONE--A bedded sedimentary deposit consisting chiefly of calcium carbonate ($CaCO_3$) which yields lime (CaO) when burned. A general term for that class of rocks which contain at least 80 percent of the carbonates of calcium or magnesium.

LIQUEFACTION--The conversion of a solid fuel, such as coal or organic waste, into liquid hydrocarbons and related compounds.

LOAD--In water quality use, the quantity of material carried by flowing water. Generally expressed as pounds per day.

LOAD FACTOR--See Plant Factor.

LOCK HOPPER--A device for introducing solids, such as coal, into a pressurized system.

LONG-RANGE VISIBILITY--The clarity of vision over a great distance. In general, the pollution factors affecting visibility are the amount of particles suspended in the atmosphere and their size distribution. Fine particulates suspended in the atmosphere scatter light. At long distances, this scattered light reduces the contrast between objects to a level below the contrast threshold of the human eye, thus limiting the distance at which different objects may be distinguished.

LONGWALL MINING--An underground method where a long (about 600 feet) mine cutting face (q.v.) is continuously sheared. Roof support is provided by a hydraulically advanced steel roof.

LOW-BTU GAS--Gas obtained by partial combustion of coal with air; energy content is usually 100-200 Btu's per cubic foot.

LOWER ORDER GOODS AND SERVICES--Those goods and services that are purchased frequently and are generally inexpensive; they are usually purchased near the consumer's place of residence (cf., Higher Order Goods and Services).

LOW-LEVEL SOURCES--Sources such as towns, strip mines, and tank farms that emit pollutants close to ground level (cf., high-level sources).

LURGI HIGH-BTU GASIFICATION--A process using a medium-pressure reactor that adds steam and oxygen to coal supported by a rotating grate to produce medium-Btu gas, which is then upgraded in a methanation (q.v.) step.

MAGNETIC SURVEY--An exploration method based on distortions in the normal magnetic field of the earth's crust.

MANTLE--A layer of loose rock fragments overlying solid rock.

MEGAWATT--1 million watts or 1,000 kilowatts. This unit is used to express the amount of power as electricity (megawatts-electric) that can be produced by a facility at any one time. One megawatt equals 1,340 horsepower.

MERCAPTAN--Any of various organic compounds containing a sulfur and hydrogen group (SH) and a hydrocarbon (q.v.) group such as CH_3. The sulfur present in the compound often causes disagreeable odors. Also known as Thiol.

METHANATION--The catalysed (q.v.) reaction of CO and H_2 to form CH_4 (methane, q.v.) and H_2O.

METHANE--A colorless, odorless, poisonous, flammable gaseous hydrocarbon, CH_4, that is a product of decomposition of organic matter in marshes or mines or of the carbonization of coal. It is used as a fuel and as a raw material in chemical synthesis. It is the principal constituent of natural gas (q.v.).

MICROWATERSHED--A very small area of a locality with one bush or shrub as the center of a catchment basin.

MILLING--A process in the uranium fuel cycle where ore which contains only .2 percent uranium oxide (q.v.) is converted into a compound called yellowcake (q.v.) which contains 80- to 83-percent uranium oxide.

MILL LEVY--A tax rate by which the assessed valuation (q.v.) is multiplied to determine the annual tax payment. It is expressed in terms of dollars of tax per $1,000 of property.

MINE-MOUTH--The vicinity or area of a mine, usually within several miles.

MINERAL CYCLES (BIOGEOCHEMICAL CYCLES)--The path which a substance (water, oxygen, nitrogen, etc.) follows as it is used in the food chain, expelled as waste, and through reaction in the environment, is returned to its original form to be used again. For example, nitrogen is incorporated in soils by bacteria, used by plants, consumed by animals, and returned to the soil and atmosphere by death and bacterial decay.

MIXING DEPTH--The height above the surface to which vertical mixing (q.v.) and neutral lapse rate (adiabatic decrease in air temperature with increasing height) occur because of mechanical turbulence and/or surface heating.

MOBILE SOURCE POLLUTANTS--Pollutants from moving sources, characteristically automobile emissions, which are generally controlled by EPA rather than state regulations.

MULTIPLIER--A factor which shows the ratio of total economic expansion to an exogenous (q.v.) increase in a local or regional economy. A multiplier may be applied to basic employment (q.v.) to derive non-basic employment (q.v.).

NAPHTHA--Any of various volatile, often flammable liquid hydrocarbon (q.v.) mixtures used chiefly as solvents and diluents.

NATURAL DRAFT COOLING TOWERS--See Cooling Towers.

NATURAL GAS--A mixture of lightweight hydrocarbons (q.v.) in geologic deposits, with its predominant compound being methane (q.v.).

NAVIGABLE WATERS--Those waters capable of being used for commerce among the states and hence subject to federal control. Under the Federal Water Pollution Control Act Amendments (q.v.) of 1972 (FWPCA), the definition of navigable waters has been expanded to make nearly all bodies of water subject to federal pollution controls.

NET ENERGY--The amount of energy that remains after the energy costs of finding, producing, upgrading, and delivering the energy have been paid.

NET PRIMARY PRODUCTION--The amount of energy available from plants; an indicator of ecosystem function and capacity (see Production).

NEW FEDERALISM--A term coined by the Nixon administration to refer to a shift in responsibility and authority away from the federal government and toward state and local governments. New Federalism was implemented primarily by means of revenue sharing, regionalization of federal agencies, and dissolution of some federal administrative responsibilities.

NEW OIL--Domestic oil produced in excess of a property's 1972 production rate or from wells drilled since 1972 (see Old Oil).

NITROGEN OXIDES (NO_x)--A class of air pollutants which includes several forms of the compound (NO, NO_2, NO_3, etc.). NO_x is produced during combustion and is one of the reactants involved in the formation of photochemical smog.

NON-BASIC EMPLOYMENT--See Economic Base Model.

NONPOINT SOURCE WATER POLLUTION--Areawide water wastes, essentially those which are transported to surface and groundwaters from sources other than pipes and ditches. These include pesticides, fertilizers, sediments, natural salts, animal wastes, plant residues, and minerals (see *Point Sources*).

NON-SIGNIFICANT DETERIORATION--Air quality standards based on an area classification system. EPA has established three classifications for clean air areas which permit progressively larger incremental additions of concentrations of SO_2 and total suspended particulates: Class I, which permits the smallest additions to protect the nation's cleanest areas such as national parks; Class II, which permits larger additions, but the allowed incremental additions are below national ambient air standards; and Class III, which permits deterioration to national secondary standards.

NUTRIENTS--Any chemical elements incorporated by a plant or animal and essential for growth and maintenance.

OIL SHALE--Sedimentary rocks containing insoluble organic matter (*kerogen*, q.v.) which can be converted into oil by heating.

OLD OIL--Domestic oil production that is equal to or lower than a property's 1972 production rate and subject to a federal ceiling price. Equivalent to "controlled crude oil".

OPERATING COSTS--Costs that vary with the level of output such as labor costs, raw material costs, supplies, etc.

ORDER OF MAGNITUDE--A range of magnitude extending from some value to 10 times that value; a 10-fold change.

OUTCROP--A place where a mineral formation is exposed to direct observation from the land surface.

OVERBURDEN--The rock, soil, etc., covering a mineral to be mined.

OXIDANTS--A class of *secondary pollutants* (q.v.), some of which are formed by photochemical processes and are capable of corrosive and/or oxidative chemical reactions.

OZONE (O_3)--An oxidant formed in atmospheric photochemical reactions.

PARENT MATERIAL--The unconsolidated mass of rock material from which the soil profile develops.

PARTICULATES--Microscopic solids that emanate from a range of sources and are widespread air pollutants. Those between 1 and 10 microns are most numerous in the atmosphere, stemming from mechanical processes and including industrial dusts, ash, etc.

PARTIES-AT-INTEREST--Individuals, groups, or organizations (such as local residents, Indian tribes, industry, labor, or various levels of government) whose interests or values are likely to be affected by the development of western energy resources.

PASQUILL STABILITY CLASSES--A system of classifying atmospheric stability on an hourly basis for research in air pollution; this system uses a matrix relating net radiation and surface wind speed (the primary determinants of air stability near the ground).

PEAK CONCENTRATION--The highest air pollutant density measured or predicted. Always cited with respect to an averaging time (q.v.).

PEAKING UNITS--Electric power generation units that are relatively small, expensive to operate, and inefficient but that are easily started or shut down. These units are used only when the electrical demand exceeds the generating capacity of the base load (q.v.) and intermediate load units.

PEAK LOAD--The highest point in consumer demand for electric power; the maximum electrical demand during some time period.

PERCHED AQUIFER--A small aquifer (q.v.) supported above the general groundwater system as in a hill.

PERCOLATION--Downward movement of water through soils.

PERMEABILITY--The ability of a porous medium to conduct fluid.

PEROXYACYL NITRATES (PAN)--Organic compounds formed in smog atmospheres that are believed to be one source of the characteristic eye irritation accompanying smog.

pH--The symbol for a scale commonly used to express degrees of acidity or alkalinity. On this scale, a pH of 1 is the strongest acid, a pH of 14 is the strongest alkali, and a pH of 7 is the point of neutrality at which there is neither acidity or alkalinity.

PHENOL--Any of various organic compounds containing a hydroxide group (OH) and a hydrocarbon (q.v.) group such as CH_3. Phenols are highly reactive compounds and are often toxic. They occur in the wastewater of some energy-producing technologies.

PILLAR--A solid mass of coal, ore, or rock left standing to support a mine roof (see Room-and-Pillar Mining).

PIT--A specific area of an open-cut minu which may refer only to that part of the mine from which coal is being actively removed or may refer to the entire contiguous mined area.

PLACER DEPOSIT--A deposit of clay, silt, sand, gravel, or similar material deposited by running water which contains particles of uranium, gold, or some other valuable mineral.

PLANT FACTOR--The ratio of the actual output of a generator over a period of time to the potential output if the generator were operating at 100 percent of capacity. Also called Load Factor.

PLUME--The generally visible or otherwise discernable column of gases and other materials emanating from an exhaust stack (q.v.).

PLUME LOOPING--Rising, falling, turning, and/or up-and-down flows of a plume (q.v.) as it responds to convection currents, eddies, and breezes due to unstable weather conditions.

PLUME OPACITY--The degree of opaqueness of a plume (q.v.) due primarily to the size, distribution, concentration, and optical properties of particles in the plume (See Long-Range Visibility). Federal New Source Performance Standards require that plume opacity be less than 20 percent.

PLURALISM--Within the confines of a common political system, the autonomous participation in and development of the special interests of members of diverse groups.

POINT SOURCE--In water pollution, those sources of water pollution which are discrete conveyances (pipes, channels, etc.) and are controlled by the effluent standards of the Federal Water Pollution Control Act Amendments (q.v.) of 1972 (FWPCA). These include effluents from municipal sewage systems, storm water runoff, industrial wastes, and animal wastes from commercial feedlots.

POND LINER--The bottom of a pond; typically, a specially prepared layer of clay (q.v.), less permeable soils, or man-made materials.

PRECURSOR--Something which precedes or suggests the course of future events (as the presence of nitrogen oxides in the atmosphere indicates or precedes the formation of nitrates).

PRIMARY AMBIENT AIR QUALITY STANDARDS--According to the Clean Air Act (q.v.) of 1970, the air quality level which must be met to protect the public health (see Secondary Air Quality Standards).

PRIMARY ECONOMIC ACTIVITIES--Those activities (employment, consumption, etc.) of man concerned with the direct use of a resource; e.g., mining, fishing, agriculture, etc.

PRIMARY EFFICIENCY--See Energy Efficiency.

PRIMARY POLLUTANT--Chemical pollutants emitted or discharged directly from facilities (cf., secondary pollutant).

PROCESS HEAT--Utilization of a fuel to produce heat for an industrial or manufacturing operation.

PRODUCTION/PRODUCTIVITY--The capacity of biological or societal organizations to produce or manufacture stored energy or other outputs, typically measured in terms of calories, Btu's, harvests or goods and services, etc. (see Net Primary Productivity).

PROFIT MARGIN--Profit as a percentage of sales.

PROFIT SHARE BIDDING--A system for making natural resources available for private development by those companies or individuals which submit the highest bids on shares of leases. Money paid for shares would be used to cover exploration costs, with any money left reverting to the government. Instead of a royalty, the federal government would retain a fixed share of the profits.

PROVINCE--The largest unit used by the U.S. Geological Survey to define the areal extent of coal resources.

PYROLYSIS--Decomposition of materials through the application of heat with insufficient oxygen for complete oxidation.

RANGELAND--Land where the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs usable by grazing animals.

RANK--A classification of coal according to percentage of fixed carbon and heat content. High rank coal is presumed to have undergone more geological and chemical change than lower rank coal.

RARE SPECIES--A species limited in abundance or encountered infrequently.

REGIONAL SCENARIO--The largest aggregated scenario, comprising the eight-state Rocky Mountain and Northern Great Plains region. The states are Montana, North Dakota, South Dakota, Wyoming, Colorado, Utah, Arizona, and New Mexico.

RESERVATION DOCTRINE--One of many mechanisms regulating water use stipulating that the federal government implied a reservation of sufficient water each time land was set aside for federal purposes. This doctrine places Indian tribes or the federal government in the position of potentially controlling vast quantities of western water.

RESERVES--Resources of known location, quantity, and quality, which are economically recoverable using currently available technologies.

RESIDUALS--The quantities of inputs to, and non-energy outputs of, the technological processes involved in energy resource development.

RESOURCES--Mineral or ore estimates that include reserves (q.v.), identified deposits that can not be presently extracted due to economical or technological reasons, and other deposits that have not been discovered but are inferred to exist.

RETORT--A structure used for distillation of volatile materials; for example, a closed heating facility used to process oil shale (q.v.).

RIPARIAN--Related to or living/located on the bank of a river or stream.

RIPARIAN WATER LAW--Common law under which the owner of land alongside a body of water is allowed a "reasonable use" of water as it passes by or through his property.

ROOM-AND-PILLAR MINING--An underground mining technique in which volumes of a coal or oil shale seam are removed and columns of the deposit are left in place to support the roof (cf., longwall mining).

ROTARY DRILL--A machine which uses a revolving bit to bore holes.

ROTARY DRILLING--A drilling method that uses a rotating bit to which a downward force is applied. The bit is fastened to and rotated by the drill string (q.v.) through which the drilling fluid is circulated.

ROTARY KILN--A heated, horizontal, rotating cylinder used to dry coal.

SALINE SOIL--A soil containing enough soluble salts to impair its productivity (q.v.) for plants but not containing an excess of exchangeable sodium.

SANDSTONE--A cemented or otherwise compacted sediment composed primarily of quartz grains of sand particle size.

SCENARIO--A projected course of actions or events; a mechanism for identifying and assessing the likely consequences of hypothetical patterns of development (see regional scenario; site specific scenario).

SCRUBBER--Equipment used to remove pollutants (such as sulfur dioxides or particulate matter) from stack gas emissions, usually by means of a liquid sorbent.

SECONDARY AMBIENT AIR QUALITY STANDARDS--According to the Clean Air Act (q.v.) of 1970, these standards specify the level of air quality that is necessary to protect the public welfare. (Welfare, according to the Clean Air Act, includes, but is not limited to: effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being.) Secondary standards are more stringent than Primary Ambient Air Quality Standards (q.v.).

SECONDARY ECONOMIC ACTIVITIES--Those activities (employment, consumption, etc.) related to the processing or manufacturing of goods (cf., Primary Economic Activities).

SECONDARY RECOVERY--Methods of obtaining oil and gas by the augmentation of reservoir energy; often by the injection of air, gas, or water into a production formation (see Tertiary Recovery).

SECONDARY POLLUTANTS--Pollutants resulting from chemical changes of substances directly discharged from facilities.

SHALE--Sedimentary or stratified rock structure generally formed by the consolidation of clay (q.v.) or clay-like material.

SHEARING MACHINE--An excavating machine used in longwall mining (q.v.) which has a rotating toothed drum that cuts parallel to the coal face.

SHIFT CONVERSION--A step in the process of converting coal to methane (q.v.); during this step, the ratio of H_2 to CO is altered to 3:1 through the use of a catalyst (q.v.).

SILT--Loose sedimentary material with rock particles usually 1/20 millimeter or less in diameter but coarser than clay (q.v.).

SILTATION--The deposition or accumulation of fine particles that are suspended throughout a body of water or in some considerable portion of it; especially the choking, filling, or covering with stream-deposited silt behind a dam or other place of retarded flow.

SITE-SPECIFIC SCENARIO--A scenario (q.v.) that postulates the development of one or more energy resources at a particular site over specified time periods using a particular combination of technologies.

SLAG--Molten or solidified ash (q.v.).

SLUDGE--A muddy or slushy deposit or sediment; the precipitate resulting from chemical treatment of water or coagulation.

SLURRY--A mixture of a liquid and a solid. Slurries of oil and coal or water and coal are used in coal processing and transportation.

SLURRY PIPELINE--A pipeline through which coal (in the form of a mixture of water and coal) is transported.

SOCIAL CONTROLS--Formal (such as administrative and regulatory) and informal (such as interest-group) sanctions relating to the various phases of energy resource development.

SOCIOECONOMIC IMPACTS--Changes in population, economy, culture, and other economic and social conditions resulting from an exogenous (q.v.) change in an area.

SPENT SHALE--The material remaining after the kerogen (q.v.) is removed from oil shale (q.v.) by retorting (q.v.). Its volume is greater than that of the original oil shale.

SPOILS--The rock, soil, etc., of the overburden after it has been broken and removed from above the coal seam.

SPOT-MARKET PRICE--The price of energy commodities sold for cash or immediate delivery.

STABILITY CLASS DISTRIBUTION--The frequency of occurrence associated with each of the six Pasquill stability classes (q.v.) on a monthly, seasonal, or annual basis at a particular location.

STACK--A tall pipe for the escape of the smoke or gases of combustion (see high-level sources).

STACK GAS--Combustion gases that result from the burning of a fossil fuel.

STACK GAS CLEANING--The removal of pollutants from combustion gases before those gases are emitted to the atmosphere.

STACK GAS SCRUBBER--See Scrubber.

STATE IMPLEMENTATION PLANS (SIP'S)--Required by the Clean Air Act (q.v.) of 1970, SIP's outline state procedures for enforcing national ambient air standards and for monitoring the performance of local programs.

STRIP MINING--A mining method that entails the complete removal of all material from over the resource to be mined in a series of rows or strips; also referred to as surface mining.

STRIPPING--The removal of earth or non-ore rock materials as required to gain access to the ore or mineral materials wanted. The process of removing overburden (q.v.) or waste material in a surface mining operation.

SUBBITUMINOUS--A low rank (q.v.) coal with low fixed carbon and high percentages of volatile matter and moisture.

SUBSIDENCE--The sinking, descending, or lowering of the land surface; the surface depression over an underground mine that has been created by subsurface caving.

SULFATES--A class of secondary pollutants (q.v.) that includes acid-sulfates and neutral metallic sulfates.

SURFACE WATER--Water occurring on the surface of the ground whether in water courses or diffused in such forms as snow and ice.

SUSPENDED SOLIDS--Sediment which is in suspension in water and which will physically settle out under quiescent conditions (cf., Dissolved Solids).

SYNCRUDE--A liquid obtained by processing oil shale (q.v.) or coal.

SYNOPTIC METEOROLOGY--The use of meteorological data obtained simultaneously over a wide area for the purpose of presenting a comprehensive and nearly instantaneous picture of the state of the atmosphere (cf., dynamic meteorology).

SYNOPTIC-SCALE FLOW--Air circulations having the scale of the migratory high and low pressure systems of the atmosphere, with horizontal dimensions on the order of 1,000 to 2,500 kilometers.

SYNTHANE HIGH-BTU GASIFICATION--A *fluidized bed* (q.v.), high-pressure reactor process using steam and oxygen, which is distinguished by the high methane yield in the initial reaction process.

SYNTHESIS GAS--Intermediate-Btu gas; almost always used as a *feedstock* (q.v.) but can be used as a starting point for the manufacture of high-Btu gas, methanol, or other products.

SYNTHETIC NATURAL GAS--Gas produced from a fossil fuel such as coal, oil shale, or organic material and having a heat content of about 1,000 *Btu's* (q.v.) per cubic foot.

SYNTHOIL LIQUEFACTION--A high-pressure, high- temperature process which makes a liquid hydrocarbon from coal by adding hydrogen to the coal using a *catalyst* (q.v.).

TAILINGS--Refuse material separated as residue in the preparation of various products such as ores.

TECHNOLOGICAL FIX--The application of technology to resolve social problems rather than seeking resolutions through behavioral or attitudinal change.

TECHNOLOGY ASSESSMENT (INTEGRATED TECHNOLOGY ASSESSMENT)--An examination (generally based on previously completed research rather than initiating new primary research) of the second and higher order consequences of technological innovation. TA attempts to balance these consequences against first-order benefits by identifying and analyzing alternative policies and implementation strategies so that the process of coping with scientific invention can occur in conjunction with, rather than after, such invention.

TERRAIN IMPACTION--Contact between a stack-gas *plume* (q.v.) and the surface of the earth, such as a mountain, plateau, etc.

TERTIARY RECOVERY--The use of heat and other methods other than fluid injection to augment oil recovery (presumably occurring after *secondary recovery* [q.v.]).

THREATENED SPECIES--Any species of fish or wildlife which is likely to become an *Endangered Species* (q.v.) within the foreseeable future throughout all or a significant part of its range.

TOPOGRAPHY--The shape of the ground surface, such as hills, mountains, or plains. Steep topography indicates steep slopes or hilly land; flat topography indicates flat land with minor undulations and gentle slopes.

TOSCO II PROCESS--A retort for producing a liquid hydrocarbon from oil shale (q.v.) that uses externally heated solid pellets to transfer heat to the shale in a reducing atmosphere.

TOTAL DISSOLVED SOLIDS (TDS)--Dissolved mineral salts generally consisting of sodium, calcium, magnesium, sulfate, chloride, and bicarbonate ions (see Dissolved Solids).

"TRADE-OFF"--Any choice between desired goals which requires one to be foregone in order to achieve the other.

TRAJECTORY--The overall sequence of individual technological processes that comprise a system of resource development.

TRANSPORT MODELING--A method of predicting ambient concentrations, both in air and water, of pollutants emitted from a source or combination of sources (see dispersion model).

TRANSPORT WIND FIELD--The set of ambient wind directions and speeds input to a transport model.

TRAPPING--The confinement of a layer of air (sometimes smog- or pollutant-laden) at ground level due to an inversion layer (q.v.) which prevents normal circulation.

TROMMEL SCREEN--A usually cylindrical or conical revolving screen used for screening or sizing substances such as rock, ore, or coal.

TURBINE--A rotary engine activated by the reaction and/or impulse of a current of pressurized fluid (water, steam, liquid metal, etc.) and usually made with a series of curved vanes on a central rotating spindle.

ULTRA-HIGH VOLTAGE (UHV) TRANSMISSION--Transmission of electrical power at 800 kilovolts or greater.

UNDERFLOW--A permeable (q.v.) deposit underlying a surface stream channel.

UNIT TRAIN--A single train used for one commodity, one origin, and one destination typically in a long-term contract (cf., dedicated railroad).

UPPER COLORADO RIVER BASIN COMPACT (1948)--An agreement that provided for division of Upper Basin waters with 50,000 acre-feet to Arizona and the remainder allocated to Colorado (51.75%), New Mexico (11.25%), Utah (23%), and Wyoming (14%).

URANIUM--A radioactive element of atomic number 92; naturally occurring uranium consists of 99.29 percent uranium-238 and .71 percent uranium-235. Uranium-235 will fission when bombarded with fast or slow neutrons; uranium-238 will fission on absorption of a fast neutron or can be converted to plutonium-239.

URANIUM OXIDE (U_3O_8)--The most common compound of uranium; used in the diffusion process of *enrichment* (q.v.).

VERTICAL MIXING--The movement of air through the layers of the atmosphere and its interaction with air from other altitudes. Vertical mixing is at a peak during unstable conditions and lowest in stable air (cf., *inversion layer*).

VISCOSITY--The property of a fluid which indicates its ability to resist flow.

VOLATILE--Readily turning to a gas (vaporizable) at relatively low temperature.

WATERSHED AREA--Surface region or area contributing to the supply of a stream or lake; drainage area, *drainage basin* (q.v.), and catchment area are other names.

WELLBORE--The hole made by the drilling bit.

WINDROSE--See *Basic Stability Windrose Information*.

WELLHEAD--The equipment used to maintain surface control of a well. It is formed of the casing head, tubing head, and *Christmas tree* (q.v.). Also refers to various parameters as they exist at the wellhead, such as wellhead pressure, wellhead price of oil, etc.

WET COOLING TOWERS--See *Cooling Towers*.

WET STEAM--A two-phase steam consisting of steam and water (cf., *dry steam*).

WORKING FLUID--Fluid in a closed loop in an electrical generation system that is heated by the energy source, expanded through the *turbine* (q.v.), cooled, and returned to the heat source.

YELLOWCAKE--The product of the *milling* (q.v.) process in the uranium fuel cycle. It contains 80- to 83-percent *Uranium Oxide* (q.v.).